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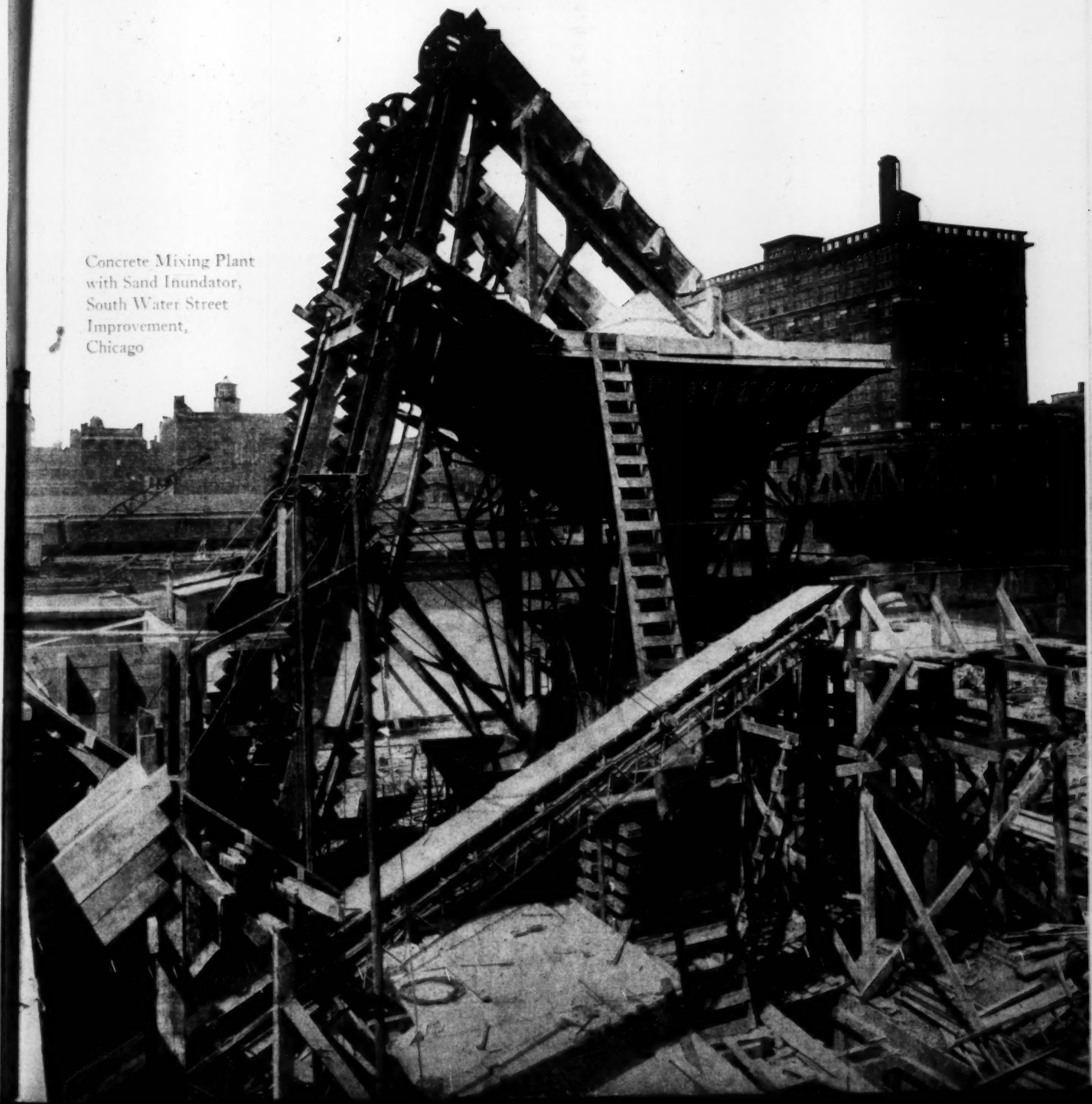

Concrete Mixing Plant with Sand Inundator, South Water Street Improvement, Chicago

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ENGINEERING NEWS-RECORD

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

FRANK C. WIGHT
Editor

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A New Departure

SOME developments at the Montreal meeting of the American Society of Civil Engineers may prove to have unusual significance for the future of the society, and may even lead to basic changes in the course and rate of its development. We refer to the board's resolutions looking toward placing greater initiative and responsibility on the technical divisions. Potentially, the future course indicated by these resolutions will provide the society with a number of self-stimulating centers of promotional activity, in place of the single one represented by the board and its agencies. The society has hitherto remained highly centralized, an integral whole in its technical activities. Excellent co-ordination resulted, but the society was left dependent for motive energy and initiative on one single source, in the last analysis. Within late years, however, the range of its work has grown so much that the restrictive effect of this limitation has begun to make itself felt. If the technical divisions are encouraged to become semi-independent in their activities, and charged with responsibilities that will develop their initiative, any danger of the society's becoming anemic or lacking in vitality will be effectively removed.

More Wages—Fewer Hours

AT ATLANTIC CITY last week the American Federation of Labor solemnly resolved that organized labor was committed to a policy of more pay and fewer hours of work. The rest of the world is doubtless committed to a similar policy, not only for labor but for itself. The difficulty is going to be to arrange things so that we all make more money and have more leisure. However, the labor leaders showed their usual shrewdness in recognizing that this delightful consummation will be reached, if at all, by the activities of the engineer in increasing production and in reducing waste.

No Export of Canadian Power

THOSE American engineers who listened to the somewhat petulant discussion of the desirability of Canada exporting her electric energy at Montreal last week will probably agree with the initial statement of the first Canadian discussor that this is hardly a subject to bring up at an engineering meeting. They will, however, reach that conclusion not on the general principle but on this specific instance of it. Certainly nothing is more pertinent to an engineering gathering than the consideration of the economic bases of power needs and distribution, even when those needs are not entirely localized to the country of the man who considers them. If engineers are to be barred from a public discussion of such matters engineering might as well revert to its now happily passed era of purely material concerns. But when a people become so obviously touchy on a subject as quite evidently some of the people, and some of the engineers, of Canada are on the subject of power export the amenities of international gatherings can best be preserved by ostentatious avoidance of any reference to such subjects. The only comment that might be made on the Montreal incident is first to observe that the engineers who were supposed to be representing Canadian views were all the employees or officers of private or public power companies there and second to question the good taste of their insistence on the half-truth that during the war Canada could not recover the power which was being exported to this country under what was considered to be a lease terminable at Canadian instance. The real facts about this incident reflect no discredit on the United States, but apparently they are locked up in the secret coffers of diplomacy. At any rate it should be obvious enough that Canada does not intend to export her power. That is her right and no one can question it. It would be much better for international amity that the whole discussion be now declared closed.

Still No Explanation

POPULAR distrust of inquiries to explain accidents or throw light on injurious conditions is not likely to be allayed by the course of the "Shenandoah" inquiry. There is still no answer to the question which the accident insistently raised: What did the Navy Department learn during the past two years to justify its apparent recklessness with respect to the dirigible? After weeks of testimony, the court finally brought out last week the underlying fact of the vessel's inherent weakness and inability to weather severe storm winds. This fact, as we indicated in our issue of Sept. 10, p. 415, was known on the best of evidence; and it formed the background of the entire disaster so obviously as to make it the item of first importance in any inquiry. It was a direct accusation of the naval authorities with the charge of unconscionable recklessness and mishandling of the "Shenandoah"—unless they could show that the service experience of the vessel thoroughly warranted their sending the vessel out on its State Fair exhibition tour with no heed to the weather and no precaution to obtain the help of meteorological observations. Only on such a justification, moreover, could they support their action in having made the vessel less safe by a number of changes, in spite of the fact that the designers had given public warning that the vessel was none too safe originally. So far, the inquiry has brought out nothing to throw any light on this conduct of the headquarters officials. Instead, many days of time have been given up to testimony bearing on possible errors of judgment of the navigating personnel. On its present showing, the inquiry gives only indifferent promise of striking at the root of the affair. But perhaps it is unreasonable to expect other results from an inquiry carried on by subordinates of the authorities who might have to be found at fault.

Choosing Counsel

WHEN a public official encounters a legal difficulty requiring the aid of an expert lawyer, he might, conceivably, request half a dozen lawyers to submit preliminary opinions on his problem, thereupon selecting from among them the one who furnished the most acceptable opinion. Conceivably, he might do so, but we have never yet heard of a lawyer being chosen by such method. In all probability the method would not select the best man, and it might easily select the worst. Public officials instinctively know better than to choose lawyers in this way. Yet they will resort to a corresponding method to select an engineer, as instanced anew by the clear-cut case represented in the correspondence printed on p. 682. Similar proceedings have become so common that they constitute the outstanding problem of professional practice today. But in most prior cases the officials involved were county commissioners and the like, men ignorant of engineering responsibilities and more skilled in politics and real-estate bargaining than in professional relations. It is possible to understand how such men might consider an invited show-your-tricks competition to be a good way of choosing the engineer who is to build an important public improvement work. It is not so easy to understand how public officials who themselves are engineers, as in the present case, will commit the same error. Yet the correspondence as printed shows that they did, and seems to leave no ground for any explanatory facts. If there are any such, any conditions that tend to furnish an adequate reason why a state highway engineer should resort to this type of competition, it is to be hoped that they will be made public. Quite apart from ethics, however, it is clear that the regular establishment of competitive selection of engineering advisers as instanced in this case will very quickly destroy entirely the status and practice of consulting engineering. It follows that any consulting engineer who takes part in such a requested and gratuitous competition is destroying his own future along with that of his colleagues.

Modern Golden Dustmen

THE Victorian "golden dustman" conducted his operations prosaically and single handed. Not so the Georgian. He does not go quite so far as to promise gold brick but he does offer to produce fuel briquettes convertible into gold sovereigns. Instead of working single handed he would organize a company—provided with capital on the strength of municipal contracts running at least ten years. More up-to-date still, the chief promoter, or at least spokesman, appends "M.B.E., M. Inst. C.E." to his name. Such in brief are the main features of a recent plan to turn London domestic refuse into fuel, noted elsewhere in this issue. The process outlined by this engineer—euphoniously called "convener" of the "conference" at which the scheme was recently submitted—is so much like those exploited in a half dozen American cities during the past ten years that one wonders whether the likeness is other than a chance one. It is only fair to add that the Metropolitan London project displays far more engineering talent than appeared this side the Atlantic and, so far as reported, is free from the stock jobbing that seemed to be the main object of the promoters who operated in the United States and Canada trying to interest the public in similar schemes.

Another Penstock Lesson

WHEN a failure of an engineering structure repeats what has occurred previously, its main value is to emphasize the costly consequence of disregard of the previous lessons. So the bursting of the Moccasin Creek penstocks reported elsewhere in this issue emphasizes the seriousness of not learning from earlier accidents. But it also raises new questions.

The initial cause of the Moccasin Creek break was "an operator's mistake in opening a valve." Previous power plant accidents have proved that mistakes will happen, and doubtless this will continue as long as operators are human. Hence safeguards that make manual controls foolproof are absolutely necessary. Such safeguards may be simple and yet be effective; the sudden opening of the hydraulic valve that caused the initial Moccasin Creek break, for instance, might have been prevented by a throttling orifice in the 1¼-in. pipe leading to the pressure cylinder. The parallel case reported in these columns last year, in which an operator's failure to manipulate a small auxiliary valve caused the penstock of Big Creek No. 8 plant to burst, was due to almost the same hydraulic causes but required other remedial measures. An improvement in the design of the control apparatus has been made which prevents repetition of the mistake regardless of any misoperation of controls.

A second point in which the accident repeats previous happenings raises a new question, that of the strength of welds in penstock sections. In at least three recent penstock failures it was welded pipe that broke. No doubt in each case the water hammer was severe enough to burst a pipe of full strength (at Big Creek No. 8 a steel flange 5 in. thick on a pipe section embedded in a concrete anchor block was cracked), yet the fact that riveted pipe was not present on the installations where the breaks occurred, and that therefore a repetitive set of failures is recorded for welded pipe, makes it natural to question the material.

In thicknesses of ¾ in. and more welded pipe is preferable to riveted pipe in respect to friction loss, weight and cost. But unfortunately welded joints do not afford the same visible evidence of bond as riveted joints. A weld failure therefore engenders distrust of welds, and by the same psychology several consecutive weld failures create a prejudice against welded pipe. Designers of penstocks have every reason to favor welded pipe for high heads but they want assurance that the scarfed metal edges brought together in the welding process have been properly fused and not merely hammered together with a limited fusion, perhaps only along the edges. Processes of manufacture may have been advanced to the point where complete fusion without any weakening of the metal can invariably be secured; nevertheless, what penstock designers really desire is some means of effectively demonstrating the strength of the welds. When that can be done satisfactorily, welded pipe will be as universally popular for high-head service as it should be.

Because the everpresent menace of water hammer involves so many factors difficult of calculation and peculiar to each installation, it would only be reasonable to make certain tests a prerequisite to putting new high-head plants in regular service. For example, with pressure gages and recording devices at various points moderate shocks could be put on the system to learn its characteristics; by repeatedly manipulating controls

and observing the effects of sudden load changes and combinations of operating conditions much might be learned that would make for greater security of operation and continuity of service.

Obvious criticism of the Moccasin Creek work lies in the statement that water poured down the hill and into the power house for more than an hour before it could be shut off, the plant having been put in service before the motors for operating the butterfly valves at the top of the penstock line were installed. Normally these valves would not have been needed in the first few days or weeks of operation, but it seems that emergency conditions are specially likely to arise when a hydroelectric plant is started up for the first time, particularly if the "tuning-up" period has been short. The urge for completion is so great that it causes the authorities to forget the danger of operating the plant before everything is ready.

Simplifying Concrete Proportioning

FOUR separate references in this issue of *Engineering News-Record* testify to the liveliness of the subject of concrete proportioning. The strength specification being used in New York by Mr. Ahlers, the similar specification in Chicago by Mr. McMillan, the developed technique of testing in Ontario under Mr. Young's direction and the satisfactory operation of inundation on the South Water St. work in Chicago, are all evidence that thinking engineers and contractors are moving beyond the theoretical consideration of the scientific control of concrete mixes into practical applications that promise both economy and efficiency. This progress has been slow but indications now are that it is being materially accelerated and concrete practice is going to be benefited by the acceleration.

It is interesting to trace the current development of this movement. For years concrete was proportioned on a purely arbitrary basis. Beginning on the Feret assumption that for a balanced mix, that is one where the sand filled the voids in the stone, the relation of the fine to coarse aggregate should be one to two, strength was assumed to be a function of the amount of cement so that a 1:6 total mix, which by the Feret deduction would be 1:2:4, would be stronger than a 1:9, or 1:3:6 mix. Water could be added according to the taste and fancy of the mixer.

Soon, however, came theories of aggregate grading, all looking toward increased density of mix and reduction of voids. Excellent theories they were, too, with much in them that the later theorists have adapted, but all the time water content was neglected and the arithmetical proportioning on the Feret basis accepted. The turn came about seven years ago when Abrams, working in the Structural Materials Research Laboratory in Chicago, discovered in his thousands of tests an ordered relation between strength of concrete and the ratio of the water to the cement in the concrete, a relation that persisted through all kinds of aggregate and all kinds of mixes, provided the resultant concrete was what could be called workable, that is of a consistency that would readily slide from mixers, fill forms and penetrate rod meshes, all without segregation or visible water. This discovery, now pretty well conceded by all investigators, was at first confused by the co-ordinate report by Abrams that the gradation of the aggregate measured by a sieve function called the fineness-modulus, was also of importance in the selection of a proper mix. This confusion was due to the possibly not justified assumption of the average man who studied the reports that both fineness-modulus and water-cement ratio were necessary to the proper proportioning for strength. There followed soon after suggestions by other investigators for the proper grading of the aggregate, all of which were tied up to the water content in the final determination of the mix.

A year or so ago, however, from various sources it began to become apparent that the rational adaptation of the water-cement ratio was just the one which in this issue is discussed by Ahlers, McMillan and Young. That is, that strength is a function of water-cement ratio and economy a function of aggregate grading and proportioning and that the two are quite separate. There followed, therefore, the radical proposal that instead of requiring the contractor to proportion his concrete by some arbitrary measure of cement and stone, that the engineer merely specify the water content to guarantee the desired strength and let the contractor put in as little stone as he could actually work with, in such proportions as to insure this workable mixture. Theory indicated, what some experience has since demonstrated, that the resulting concrete would be uniform and strong, which the engineer wanted, and economical, which both the contractor and the engineer wanted. Further than that, it is being discovered that grading by inspection, based on experience, is apt to be as economical as the more elaborate theoretical measures at first advocated.

This is the stage to which the most advanced of the workers in this field have now arrived. More and more the theories and methods they advocate are beginning to penetrate into the denseness of custom which still controls the vast majority of concrete mixed. Only slowly can be overcome the inertia of the man who prides himself on knowing all about concrete because he has been placing it the same way for twenty years.

Let it not be thought that the new methods mean the routinizing of concrete making. Rather the contrary, for we have here the substitution for the rote of 1:2:4, the preliminary study and constant supervision of the trained observer and tester. For every job there has to be careful study of available aggregate to determine just what mix is the most economical and what is the proper water-cement ratio to be used with it. And that having been established there is required throughout the manufacturing process a precision in measurement and care in mixing and placing unknown under the old regime of letting 1:2:4 take care of everything. Weighing of aggregate, as practiced by Mr. Young, inundation as so satisfactorily used on the Chicago's double-deck street, the careful water-cement balancer devised by Mr. Ahlers, all pay dividends in uniform and better concrete.

The whole story of good concrete is not covered by high strength, but to a considerable degree it is covered by uniformity of product. Strength though a fair measure of all properties is not a perfect one, but a strong concrete, uniform in texture, lacking voids, without laitance seams, is the nearest approach we can make to the perfect concrete in our present failure of complete knowledge of the setting processes of cement. We are today in much better prospect of getting such a concrete through the medium of the simpler proportioning specification, with its attendant carefulness of control, than we have ever been before.

Construction Methods on Double-Deck Street, Chicago

Careful Planning and Close Execution of Concrete Work—Proportioning by Fineness Modulus and Cement-Water Ratio—Sand Inundation Highly Successful

A NINE-MILLION dollar construction operation is involved in double decking South Water St. in Chicago and building a marginal dock for 3,600 ft. along the south bank of the Chicago River. Design and structure were described in detail in *Engineering News-Record*, Oct. 15, 1925, p. 617. To make clear the construction required, however, the perspective sketch and top deck plan, Fig. 1, are shown herewith. The plan shows the twelve contract sections into which the work was divided. The total quantities are: 300,000 cu.yd. excavation, 120,000 cu.yd. concrete, 9,200 tons, steel, 135,000 sq.yd., pavement and 120,000 lin.ft. of piling. Contracts have been awarded and work is completed or in progress on seven of the twelve sections. To illustrate construction, one contractor's operations are described; these cover Sections 3, 4, 5 *A*, 10 and 11, the price of each of which is about $800,000.

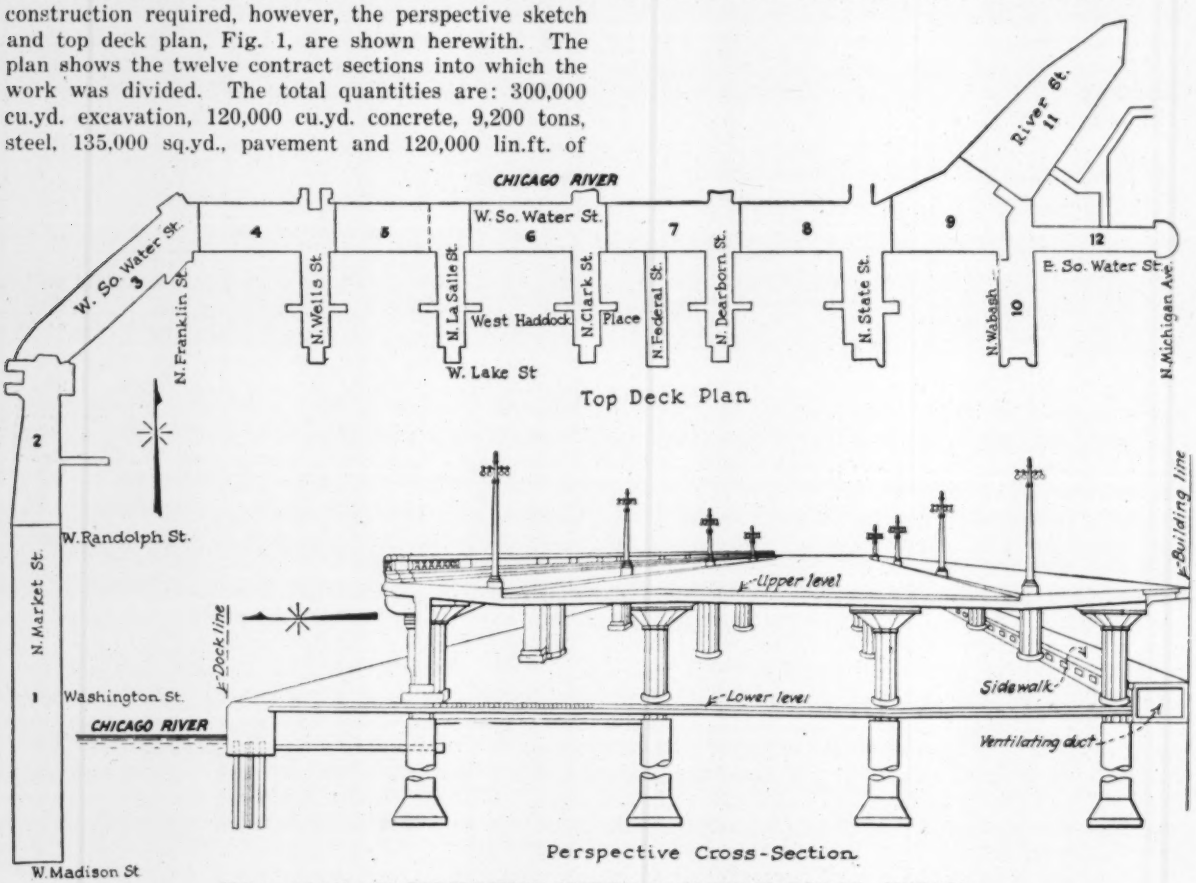


FIG. 1—PLAN AND PERSPECTIVE SECTION OF SOUTH WATER ST., CHICAGO

Planning Control—Construction control was planned ahead as carefully as was design of structure. The operation is essentially structural reinforced-concrete work. Quality of concrete therefore was the thing chiefly important to control. This was sought in two principal ways: (1) Sand inundation and (2) proportioning by fineness modulus and water-cement ratio. The sieve analysis required of the sand called for 85 per cent passing No. 4; passing No. 50, 30 per cent maximum and 10 per cent minimum; passing No. 10 not over 2 per cent and loss by decantation not over 3 per cent. For the structural concrete (virtually all concrete except in pavement, gutters and sidewalk laid on the ground) the following size analysis was required of coarse aggregate: Passing $\frac{3}{4}$ in., 95 per cent minimum, passing $\frac{3}{8}$ in. 40 to 75 per cent, and passing No. 4 not over 5 per cent. In all tests, A.S.T.M. methods and requirements governed. A 1:6 concrete was designated with 7 gal. of water, inclusive of moisture in the aggregate, per sack of cement.

Sand inundation was perhaps the outstanding uncommon feature to be required by specification. In addition to eliminating the uncertainty of using sand with unknown and varying moisture content, the use of inundated sand, it was considered, speeded up the hydration of the cement and also gave a mixture that flows more freely with a smaller amount of water. The use of a mechanical "inundator" was specified. To assure uniform consistency, slump tests were required, of concrete as it went into the forms; a 3 to 4-in. slump was specified. Also frequent samples were taken for cylinders for 7 and 28-day compression tests. It may be noted here that 28-day 1:6 concrete has been giving 4,000 lb., and an average weight dry of 150 lb. a cubic foot.

In general the specifications for workmanship are those of high class structural work. Very particular care is taken to see that reinforcement is embedded and that spading and puddling are thorough enough to

give a good surface. In all reinforced concrete, hydrated lime is used—8 lb. added to the mix for each sack (94 lb.) of cement. Chuting into forms is prohibited.

Concreting Methods—The five contract sections completed or being built by the Mid-Continent Construction Co. indicate methods of carrying out the concreting plans. This company has three concreting outfits to top-deck hoppers which feed into carts. Some concrete, however, has been hoisted in carts by building lifts or elevators. There are too, besides the three main plants, two half-yard and one quarter-yard portable mixers for special operations.

In detail the equipment of one of the outfits shown by Figs. 2 and 3 is: A 1-cu.yd. batch-hopper mixer; a 120-ton steel sand and stone bin; a stone batcher; a sand

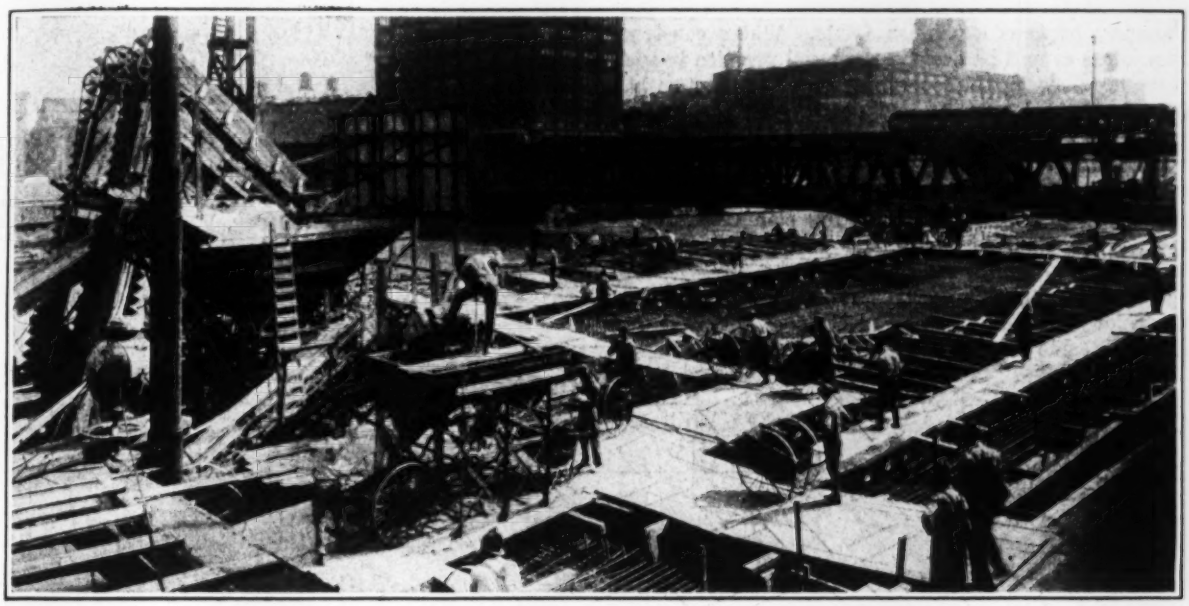


FIG. 2—MIXING PLANT, CART CHARGING HOPPER AND CART RUNWAYS

complete with inundators as illustrated by Figs. 2 and 3. They stand on the lower level and extend up through the top deck. Concrete materials come in at the lower level by truck, and are conveyor elevated to the overhead bins and charging floor. Concrete discharged at the lower level goes into carts for lower level work or onto belt conveyors which take it

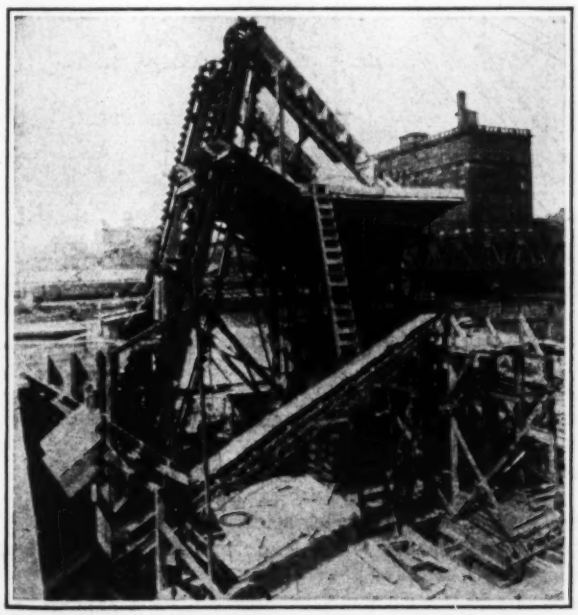


FIG. 3—ONE OF THE MIXING PLANTS WITH SAND INUNDATOR

inundator; two 55-ft. bucket elevators for sand and stone; a 50-ft. belt conveyor for cement in bags and a 55-ft. belt conveyor for concrete. About the only special unit is the sand inundator. This device was described in *Engineering News-Record*, May 7, 1925, p. 775, and need not be explained in detail. Briefly the inundator is a steel drum of fixed volume suspended under the sand bin. This drum is partly filled with water—about one-third full. Then sand is gated into the drum until it is filled to the top, any surplus water overflowing. The drumful of saturated sand is then rotated and dumped into the mixer hopper; any more water required to give the specified volume per sack of cement is then added in the usual manner and the batch is mixed.

A crew of 19 men operates one outfit. Eleven men handle the cement from stock, load the conveyor and empty the bags into the mixer charging hopper. One man operates the inundator, one the stone batcher, one the mixer, three work on the concrete conveyor, one chutes the concrete into the carts and there is one engineer. Distribution is by hand carts operated on runways as shown by Fig. 2. The cart gang varies with the work being done. All concrete is mixed 1½ minutes.

In placing, four requirements are principally to be noted besides the usual practices in first-class structural work. No concrete is permitted to be chuted into the forms—all has to be carried in and poured from carts. Before placing concrete, after the reinforcement is in place, the bottoms of column, girder and slab forms have to be filled with mortar 6 in. deep in columns, 1 to 2 in. deep in girders and ½ in. deep in slabs. An exceptional amount of puddling is re-

quired to ensure density and also to get a thick mortar surface, as virtually all of the structure will have exposed surface. In curing, tops of slabs have to be covered with an inch of sand kept moist and other parts sprinkled twice daily for from one to two weeks.

In general, concreting has been scheduled to keep down the number of expansion joints. Columns are poured in one operation to the level of the underside of the drop panels, Fig. 4, and deck is poured continuously between expansion joints. Where construction joints cannot be avoided the usual practice in such cases is followed. In concreting deck the practice has been to make long runs and on occasion the records have been remarkable. On Aug. 10, 1,080 cu.yd. were poured in half a block of slab. Pouring began at 6 a.m. and was finished at 1:30 a.m., the following morning. Two of the main mixing plants were operated. A ½-cu.yd. portable mixer produced the mortar for slab and beam bottoms and the granite finish for the sidewalk. On Aug. 21 about the same yardage was poured in one hour less time and on Sept. 18, 1,000 cu.yd. were poured between 6 a.m. and 10 p.m.

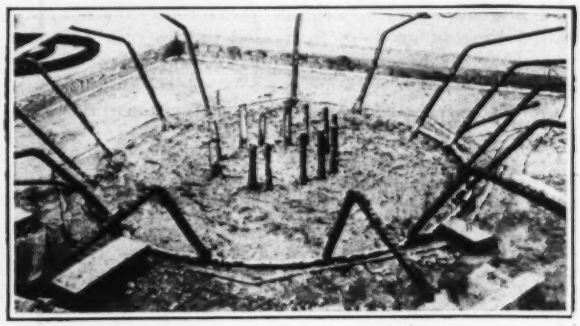


FIG. 4—COLUMN CONCRETED TO BOTTOM OF DROP PANEL

prohibit any "non-freezing" admixture to the cement. They also require that the initial temperature of the concrete in place shall be 50 deg. F. and that the air temperature about the concrete shall be kept at least

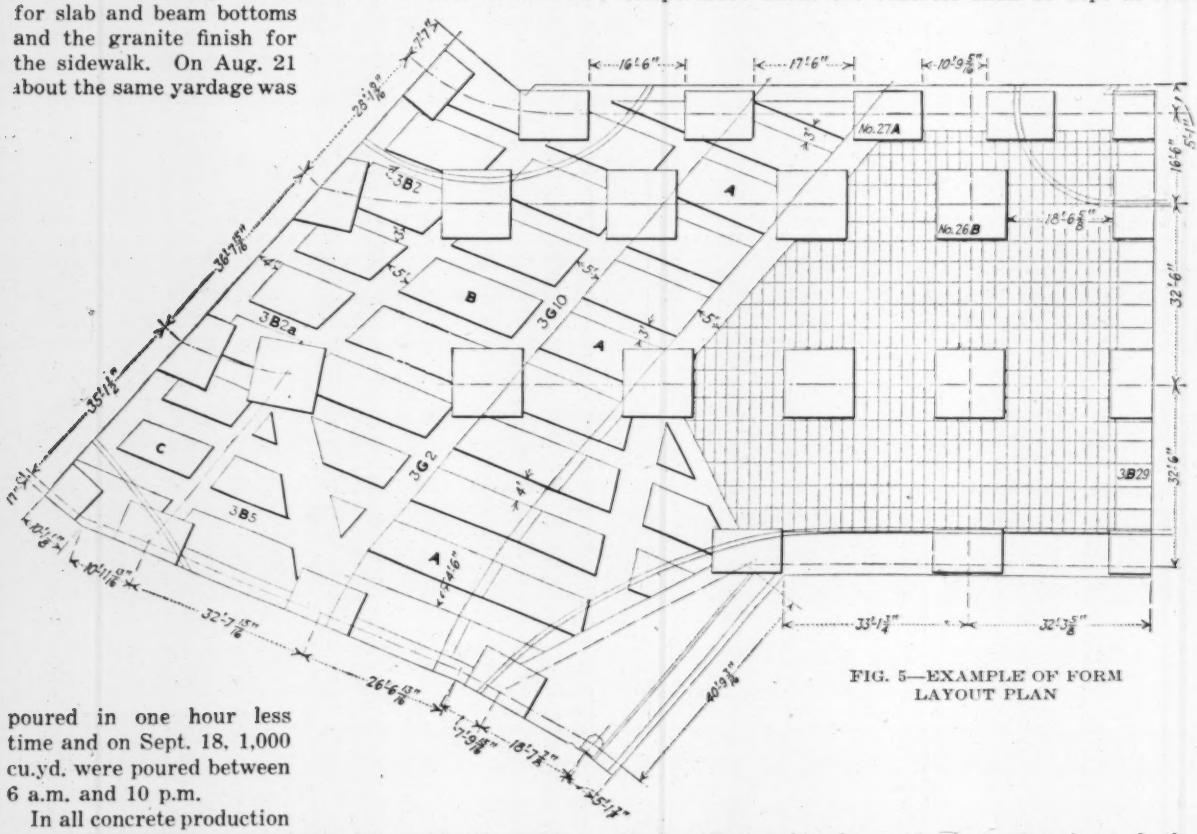


FIG. 5—EXAMPLE OF FORM LAYOUT PLAN

In all concrete production very close conformance is being kept with the requirements laid down. Cement tests, sieve analysis of aggregates, and cement-water ratio are rigidly enforced, and consistency is held uniform by the slump test. Cement and aggregates are tested at the source, but other test regulation is done on the job. The result is notably uniform and fine appearing concrete in structure. It is being obtained too without excessive exaction on the contractor. He particularly is pleased with the sand inundation feature and expresses his decision to use it as his regular practice regardless of requirements.

Virtually the only variation from the normal practice described is in work done last winter and to be done this winter. In winter work the specifications require the hydrated lime to be omitted and indeed 60 deg. F. for five days. On last winter's work the contractor provided an 80-hp. boiler to supply steam coils in the aggregate bins and a 500-gal. tank heated with exhaust steam, for each mixing plant. Forms were packed with 12 in. of marsh hay. With this arrangement concrete regularly was put into the forms at 100 deg. F. and the thermometers against the form boards registered 70 deg. F. after seven days.

Form Construction—Very careful study was given to his formwork by the contractor. For every section—between expansion joints—a form plan was laid out. For many sections these were substantially duplicates and one plan with slight modifications did for all. A form layout is shown by Fig. 5. Only a few dimensions and beam numbers are shown but on the drawing

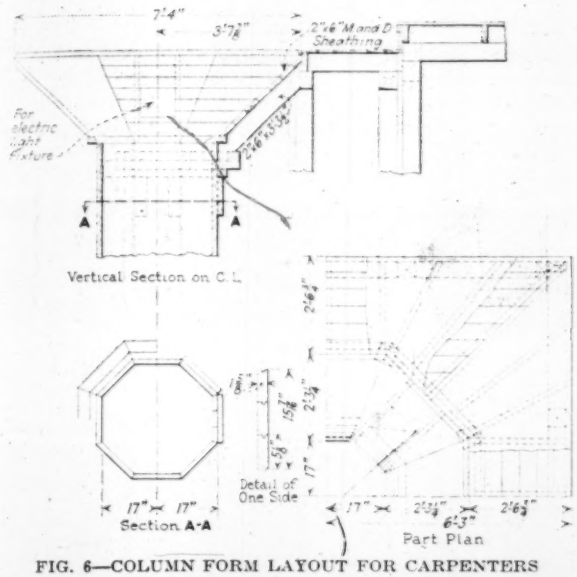


FIG. 6—COLUMN FORM LAYOUT FOR CARPENTERS

units, as column forms, working drawings are given to the carpenters. Fig. 6 is a working drawing for one of the standard column forms. Here also only a few dimensions and number designations are shown.

With drawings for forms almost as detailed as drawings for fabricating steelwork, the contractor's engineers go onto the job and by explanation make certain that sawyers and carpenters can read them correctly. This care is found to pay by reducing wastage and cutting down lost motion and delays in fabrication and erection. In a normal section, 150 ft. of standard structure, there are approximately 200,000 sq.ft. of form area. About 8 ft. b.m. of lumber is required for each foot of area. This lumber is being used two or three times. There is in general no more form complexity than is common in structural concrete work.

Reinforcement—Reinforcement as shown by Fig. 8 calls for a close network of steel but for no greater difficulties than good structural work ordinarily imposes. There is, however, very rigid inspection to secure and keep accurate placing and particularly to see that the metal is well covered.

Special Problems—There was a considerable foundation construction task but the familiar Chicago methods of putting down wells in clay served except in a few cases where water gave trouble. At some of the intersections street surface structures and in one case a crossing elevated railway had to be put on falsework and underpinned. These special problems required the usual fussing and care but offered no serious difficulties.

FIG. 8—PLACING FLAT SLAB REINFORCEMENT IN STANDARD DECK

every panel, beam or other form is designated. Then cutting plans are given to the sawyers, and for built-up

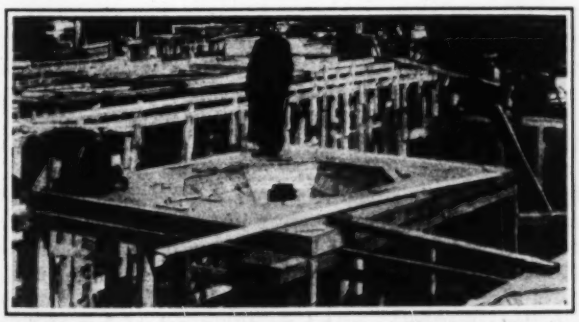


FIG. 7—COLUMN FORM TOP AND DROP PANEL BOTTOM

Direction of Work—Construction was begun in November, 1924, and, working through the winter, section 3 was completed in 6 months. The schedule for the other sections is 4 months. The contractor whose work has been described is the Mid-Continent Construction Co., Chicago, F. J. Herlihy, president, J. W. Musham, chief engineer and C. J. Herlihy, general superintendent. The construction is under the direction of the Board of Local Improvements, John J. Sloan, president, and T. A. Evans, engineer of design.

Further Data on Moccasin Creek Penstock Breaks

Defective Welds Give Way When Operator's Mistake in Opening Hydraulic Valve Causes Severe Water Hammer

DAMAGE sustained by the Moccasin Creek power plant on San Francisco's municipally owned and operated Hetch Hetchy project as the result of an accident which ruptured three penstock lines and flooded the power house on June 30, was repaired and the plant was again carrying full load about six weeks after the break. Some details in addition to the news report of the break, published in *Engineering News-Record*, July 9, p. 78, are given in the following:

On the morning of the break units 1, 2 and 4 were operating and unit 3 was shut down for inspection of exciter brushes. Both the penstock and bypass valves on this unit were closed. At 6:58 a.m. the chief operator instructed an assistant to open the north bypass and gate valve on unit 3 preparatory to starting up the unit. The assistant started to carry out this order but neglected to first open the bypass valve, which would fill the section of pipe between the nozzle and the main gate valve, before opening the main gate valve itself.

A violent water hammer resulted. The chart on the recording pressure gage shows the pen to have swung from one limit stop to the other, a range of from 300 to 800 lb. per sq.in. Likewise the needles of the indicating gages are reported by a man standing at the gage board to have swung from limit to limit, a range of 0 to 1,000 lb. per sq.in. The normal pressure under operating conditions at the time was 525 lb.

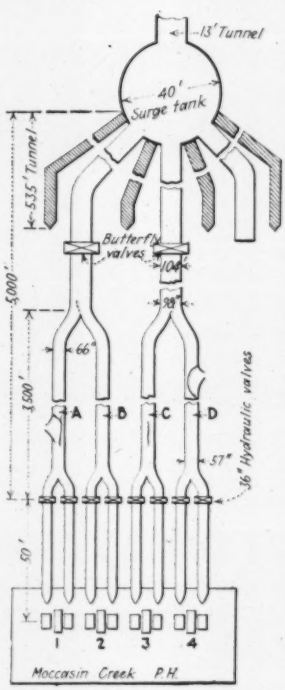


FIG. 1—MOCCASIN CREEK PENSTOCK BREAKS

Immediately after the loud reports that are stated to have accompanied the water hammer, the *D* penstock burst and water poured down the hill toward the power house. Under the direction of the chief operator, all three units then operating were shut down as speedily as possible and all the circuits were promptly deenergized. These operations were completed and all switches were open by 7:06 a.m., the power-house log shows, and the flood entered the station at about 7:10 a.m.

The *A* line, according to all accounts, did not give way until some minutes later—"from ten to fifteen minutes after the *D* line and from no apparent direct cause," says the official report of the chief operator. The *A* line opened up on the side away from the *B* line and was thrown over against the latter by the reaction. Later it was discovered that a narrow split or fissure some 10 to 14 in. long had developed in the *C* line and that plates in both wyes at the top of the hill had been bent and torn. These wyes were described in *Engineering News-Record*, July 30, 1925, p. 189. The relative positions of the penstock lines and the units they serve will be understood from the accompanying sketch.

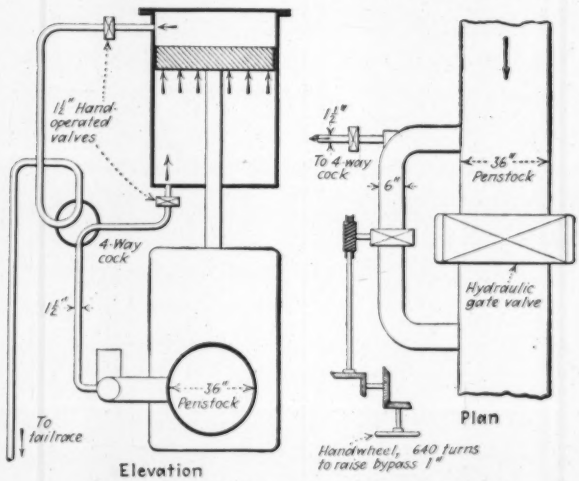


FIG. 2—PLAN AND ELEVATION OF 36-IN. HYDRAULIC VALVE

Difference of opinion exists as to the condition of the metal in the *A* and *B* lines where the pipe sections were split open, but in both cases the breaks passed through solid (unwelded) metal, through welds showing a good surface and through welds showing defective surface. In some places it appeared that actual fusion in the weld had occurred only on a thin edge along the outer surface of the pipe. On this score the report of the city engineer to the board of public works states: "The breaks in *A* and *D* lines revealed flaws in the welds about 6 to 8 in. in length."

All these pipe sections had been tested at the factory under the inspection of a representative of the San Francisco city engineer's office to a pressure 50 per cent above the normal static head. The lines were similarly tested in the field during installation.

While the bursting of the *D* line may be accounted for by the transmission of shock from the valve in the *C* line through the water column and the wye connection between *C* and *D*, the break in the *A* line is not so easily explained. Some engineers believe that reflection of the *C*-line pressure wave at the surge chamber and thence down the *A* line was responsible. Others believe that when the operator shut down the wheels after the first break the valve of the *A* line was closed so rapidly as to set up water hammer in this line severe enough to break it.

Although exact time intervals cannot be established it is generally agreed that the *A* line break occurred after the shutdown of the plant has been completed. No other direct evidence concerning it is available, however.

All the 36-in. hydraulic valves just outside the power house, except one of the two on unit 1, had been adjusted to require 5 minutes to open or close, the operator's report states. It is to be noted, however, that the time-limit control on these valves is not in the form of an orifice of suitable diameter but is

effected by means of cocks in the pipe leading to the water-pressure cylinders. These cocks, of course, could be opened at will by hand. The operation of the hydraulic valves will be understood from the schematic plan and elevation sketch together with the picture of the control bay in which the 4-way cock levers are shown. In the picture the cock at the right is in the

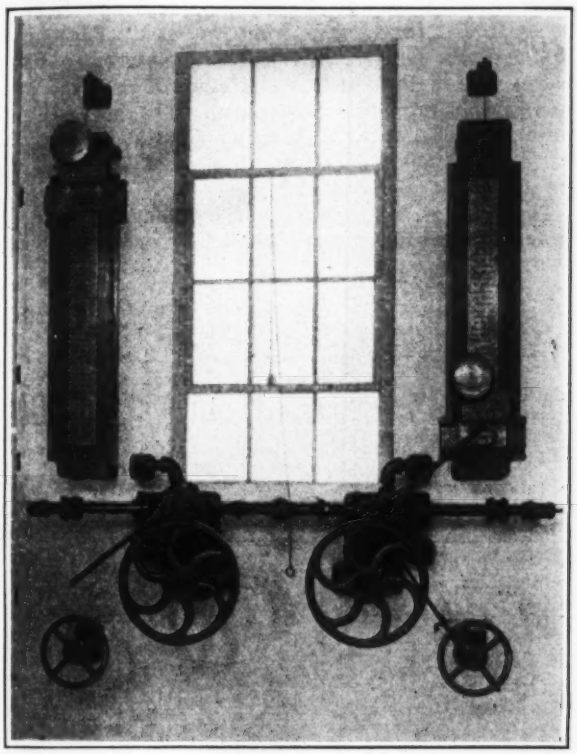


FIG. 3—FOUR-WAY COCKS CONTROLLING OPERATION OF 36-IN. VALVES

closed position and the one at the left is open. There are three positions of the levers, corresponding to neutral or to either one of two water circuit combinations. Each combination puts pressure on one side of the piston in the cylinder and vents the other side, thus moving the valve to open or closed position.

An hour and twenty minutes elapsed after the break before the water pouring down the hillside from the broken penstocks could be shut off. This delay was occasioned by the necessity of starting up a compressor plant and using an improvised means of closing the butterfly valves at the upper end of the penstocks. The installation of remote-control electrical equipment for operating these valves had not been completed when the break occurred.

According to the M. W. Kellogg Co., which constructed the penstocks, they were designed for a tensile stress under static load of 11,500 lb. per sq.in., and were made from single sheets, with oval longitudinal but no transverse welds. The joints between lengths were made by bumped joints riveted. The test pressure, 50 per cent above static service pressure, was such as to give a tensile stress 50 per cent above design stress, or 17,250 lb. per sq.in. The material was bought under the A.S.T.M. specification for steel for forge welding, and had an ultimate strength of slightly over 50,000 lb. per sq.in. and a minimum yield-point ranging down to about 25,000. The company calls attention to the fact that the design stress used for these penstocks (specified by the city) was higher than that of any other penstock they have built, values of 10,000 and even 9,000 being used in other cases. It considers that the test pressure should not go beyond about 18,000 lb. per sq.in. in order to avoid affecting the metal by exceeding the elastic limit, so that in order to obtain a high percentage of overpressure in the hydraulic test the design stress should be kept down.

Repairs in the *A* and *D* lines were made by cutting out the damaged sections and riveting into the gaps new riveted sections of the same thickness. The split in the *C* line was welded and reinforced by a riveted band around the pipe at this point.

In the wyes the splitter plates which had been bent by the sudden rush of water were jacked back into position and tears in the curved plates adjoining were welded and covered with patches riveted in place. A considerable part of the delay in getting the plant in operation again was due to the time required to dry out the generators and other apparatus that had been flooded.

Still further investigation and study of hydraulic conditions and the results of various operations of controls are being made in order to collect all information possible on the subject.

Bidding Plans for Structural Steelwork Defined

A COMMITTEE of engineers and steel contractors named by the Structural Steel Board of Trade, of New York City, to define how structural steel plans should be made in order to permit satisfactory bidding, has just rendered a report, which was adopted by the board as a supplement to its decision not to submit pound-price bids for steelwork after Nov. 1, 1925. The committee was composed of H. G. Balcom, C. J. Jeppesen, and S. F. Holtzman, engineers; and J. L. Hay, J. Loewenstein, and G. Lund, contractors. The requirements as formulated by the committee are:

1. That all plans be prepared according to the best engineering practice, showing all labor and material of the various classifications required and specifying the conditions under which the work is to be performed.

2. That all plans shall show a complete design, with sizes, sections and relative location of the various members, with floor levels, column centers and offsets figured, and shall also show the character of the work to be performed with sufficient dimensions to permit the making of an accurate estimate. Plans to be made to scale not less than ⅛ of an inch to the foot and large enough to convey the information adequately.

3. That wind bracing and special details when required shall be shown in sufficient detail regarding rivets and construction to permit an accurate estimate of the cost.

4. That specifications shall definitely enumerate all the items to be included in the estimate, and in all respects not covered by the specifications the code of standard practice of the American Institute of Steel Construction shall govern.

5. That inspection be called for in specifications under "Inspection." That amount of money to be included be specified, and that the inspector be appointed by the engineer.

As noted, the Structural Steel Board of Trade adopted this recommendation as a fair and reasonable requirement for plans, for lump sum estimates and bids.

Underpinning Trinity Church with Pipe Piles

Work Undertaken Because of Settlement of Rear End of Church Requires Piles Jacked to Depth of 74 Feet

By H. de B. Parsons
Consulting Engineer, New York City

UNDERPINNING the chancel and western end of Trinity Church, at Broadway and Wall St., New York, is probably the largest single underpinning operation using hydraulic jacks ever undertaken. The details of the work will be found interesting on account of the number, and, for this type of pile, the extreme lengths of piles used.

The main portion of the present church was completed in 1846, being the third church erected on this site. The first, built in 1697 and enlarged in 1737, was destroyed in the great fire of 1776 and was not replaced until 1790. This second church was in use until 1839, when it was declared unsafe and torn down to allow the erection of the present building. The sacristy and choir room were added to the church in 1877 and All Saints Chapel, at the northwest corner, in 1912. The structure is built of brownstone, and the footing course consists of flat stones laid in foundation trenches about 13 ft. below the churchyard. The foundation walls vary from 3 to 6 ft. in thickness, and, except for those of recent construction under the chapel, are laid in lime mortar.

Reason for Underpinning—Until 1913 few cracks were visible in the structure and apparently there had been little settlement since its completion. In that year subway construction in Trinity Place was commenced, and the retaining wall between the churchyard and Trinity Place (Figs. 1 and 2) was underpinned by the city to permit excavation for the subway. From that time on, cracks in the church structure became prominent and the rear end of the church settled about 1¼ in. This settlement was practically zero at a line through buttresses *A* and *V* and became a maximum at buttress *L*. To preserve the structure, the vestry decided to underpin the western end of the church.

General Conditions—The author designed the underpinning and prepared the specifications. Bids were invited and limited strictly to contractors receiving invitations. Borings were made at four points near the church. A 2½-in. pipe was jetted down until rock was reached, after which a diamond drill core from 5 to 10 ft. long was taken from the rock. For about 25 ft. down the ground consists of coarse, reddish-brown sand, below which is a mixture of fine sand and reddish clay extending to hardpan. The thickness of hardpan overlying the rock varies from about 1 to 11 ft. Rock (Manhattan schist) lies about 74 ft. below the surface of the ground.

The piles were made of varying lengths of steel tubing, connected by cast-steel collars and filled with concrete after being jacked down into hardpan. Each pile was tested by applying a load before the weight of the wall was transferred permanently to the pile. Three sizes of tubing were used, 12 in. inside diameter and 15 and 16 in. outside diameter, all having a wall thickness of ⅜ in. The loads which the piles were specified to carry safely were 70 tons for the 12-in. piles and 90 and 100 tons for the 15-in. and 16-in. piles respectively. The piles were so spaced, however, that the actual load per pile was from 10 to 15 tons less than these specified loads. In all 92 piles were sunk.

Underpinning Operations—In sinking a pile, a pit 4x4 ft. was dug close to the wall of the church, being sheeted horizontally with 2x8-in. planks closely fitted in place as the excavation was made. The pit was carried down until the bottom was about 4 ft. below the wall footing, then offset to get under the wall and continued about 3 ft., giving a working chamber about 7 ft. high. The first length of steel tubing was then

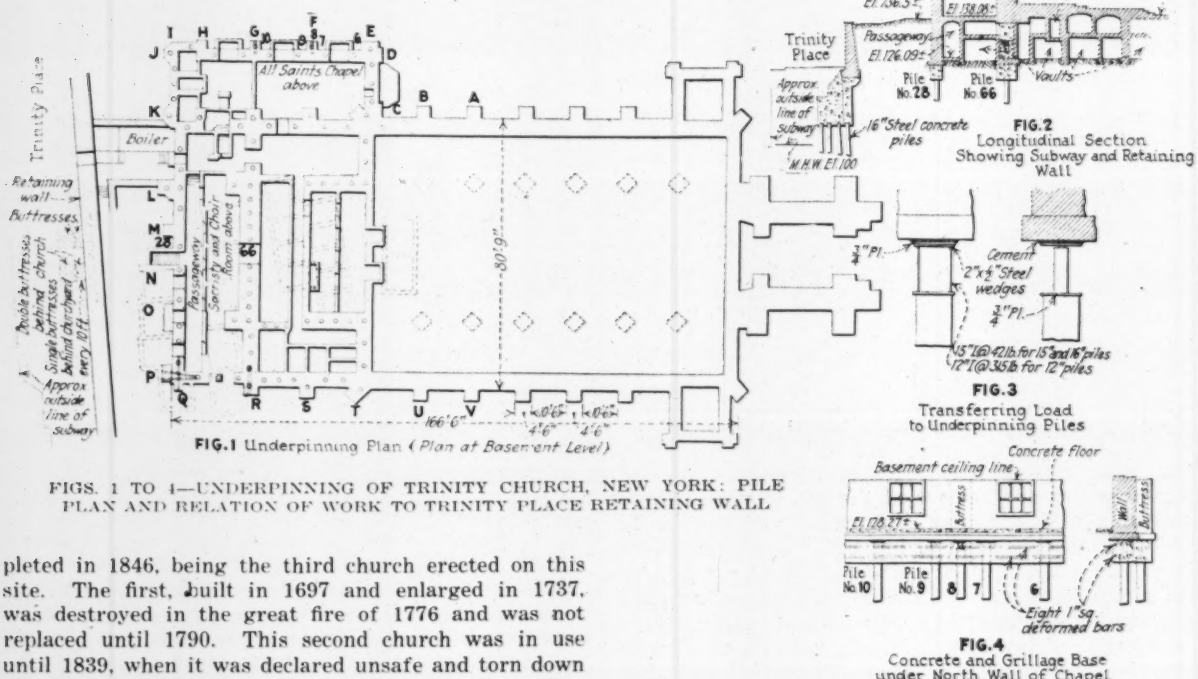


FIG. 1 Underpinning Plan (Plan at Basement Level)

FIG. 2 Longitudinal Section Showing Subway and Retaining Wall

FIG. 3 Transferring Load to Underpinning Piles

FIG. 4 Concrete and Grillage Base under North Wall of Chapel

FIGS. 1 TO 4—UNDERPINNING OF TRINITY CHURCH, NEW YORK: PILE PLAN AND RELATION OF WORK TO TRINITY PLACE RETAINING WALL

placed below the point to be underpinned and a ¾-in. steel plate was set in cement on the under side of the wall footing to resist the thrust of the jack. The tubing was covered with a 1-in. steel plate to support a hydraulic jack 4½ in. in diameter. Pressure supplied the jack was maintained at about 5,000 lb. per sq.in. by means of a hydraulic accumulator. As the pressure was applied to the jack, the plunger, acting against

FIG. 5—TRINITY CHURCH AS SEEN FROM SOUTHEAST

the wall footing, forced the tubing down into the sand. When the plunger was extended its full length, pressure was released and wedging blocks, consisting of 6-in. concrete-filled pipe with lengths varying from 6 in. to 3 ft., were inserted between the plunger and the footing course to permit further jacking. In this manner the first length was driven into the ground. Then a cast-steel collar was inserted, after being wrapped in oakum and smeared with tar to make a watertight joint. The collars were tapered to fit inside the tubing, and had a central rib for bearing for the next length.

After the second length of tubing was set in place, a jet hose 2 in. in diameter, reduced to ¾ in. at the nozzle opening, and a 3-in. suction hose were inserted in the casing through a notch in the 1-in. plate supporting the jack. During the jacking of all subsequent lengths, the sand within the tubing was stirred up by the jet and removed with the water through the suction hose as the pipe was jacked down. Constant vigilance was exerted to keep the jet at least 4 ft. above the cutting edge of the tubing, so that no ground might be taken from outside the pipe, with consequent danger of settlement by the structure. By keeping a record of the lengths of tubing as they were put in place, and by means of permanent graduations on the jet hose, the operator of the jack knew at all times the relative positions of the jet and the cutting edge of the tubing. Work proceeded in this manner until the casing was forced into hardpan.

In jetting the piles down, the water was used repeatedly. The suction hose was attached to a mud hog pump which delivered the water with the sand and clay in suspension into large settling tanks erected in the churchyard. The sand and clay were removed by sedimentation and the effluent passed into a tank used as a reservoir for the jet pump.

When a casing reached hardpan, resistance to jacking increased at once, giving the operator notice that the pipe was "down." The tubing was then mucked out and a sample of the material at the bottom was brought up by a small orangepeel bucket. In this manner positive evidence was obtained that the tubing had reached hardpan. Then concrete was lowered by means of a bottom-dumping bucket to form a seal at the bottom of the pipe, and the water in the tubing was pumped and bailed out. The tubing was then inspected for straightness and tightness.

The casings were filled with 1:1½:3 concrete, using a dry mix to give increased strength. The coarse sand removed from the pits was found suitable for making concrete, as it contained practically no loam or organic matter. Cow Bay gravel was used as coarse aggregate. Before filling with concrete, the top section of tubing was so set on its collar that a 1½-in. space was left between the central rib of the collar and the edge of the tubing. When the test load was applied to the pile, the top length of pipe was forced down to bearing on its collar and at the same time the fresh concrete in the casing was compressed, increasing its density.

Test Loading—Each pile was tested by applying a load of about 125 per cent of that which the pile was designed to carry. When possible the test load was applied immediately after filling the casing with concrete. Where that was not practicable, the load was applied not earlier than 30 hours after filling, to give the concrete time to set.

In testing the pipes two jacks were used, either 4½ in. or 6 in. in diameter, depending on the size of the pile. A ¾-in. steel plate was placed on top of the pile and the jacks were set on the plate, leaving room between them to permit the insertion of a I-beam strut. The load applied to the pile was measured by a hydraulic gage attached to the testing jacks. As the load was increased, some settlement took place, since the test load used was greater than that applied in sinking the casing. The pressure was held constant, however, until all settlement ceased under the test load. Measurements of the settlement were made while the test was conducted, and occasionally, as a matter of interest, the rebound of the pile was measured when the load was removed. The recorded settlements varied from ¼ in. to 1⅜ in., while the rebounds were about ⅛ in. The larger values of the settlements were probably due more to the closing of some of the joints in the casing than to movement of the pile into hardpan.

When all settlement of the pile had ceased, an I-beam

strut was cut of proper length to reach from the steel plate on top of the pile to the plate cemented to the footing course. The strut was inserted between the two jacks while the pile was under load, and two wedges were then forced between the strut and the top plate until the jacks were released (sketch Fig. 3 and view Fig. 6). In this manner the weight of the wall was

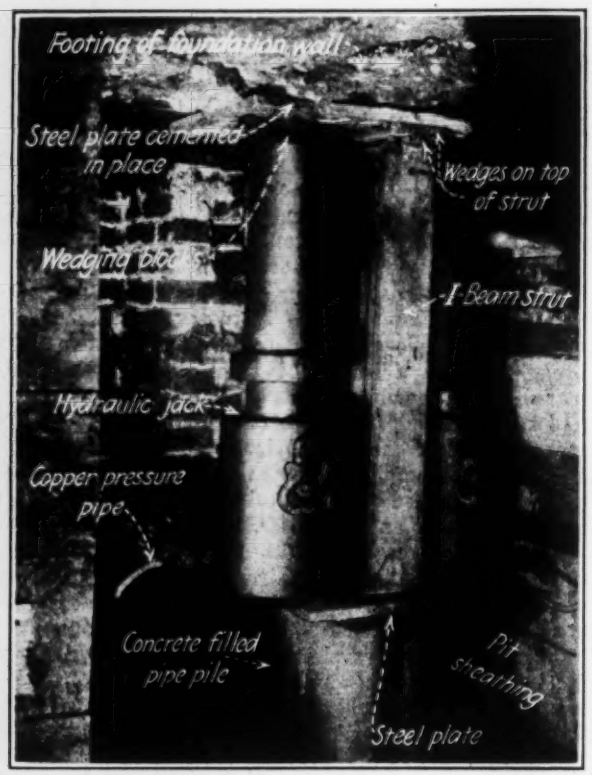


FIG. 6—WEDGING STRUT BETWEEN PILE AND WALL FOOTING

transferred from the jacks to the strut. When the jacks were removed, it was with certainty that the pile was carrying its proper load.

After wedging the pile, the pit sheathing was removed and the pit backfilled with well tamped wet sand to a height about 1 ft. below the top of the pile. Then a mixture of 1:2½:5 concrete was placed on top of the compacted backfill, encasing the top of the tubing, the steel plate and the strut. This concrete was carried up to a point about 6 in. below the wall footing and allowed to set. After setting, any laitance present on top of the concrete was removed and the space between concrete and wall footing was hand-packed with a stiff 1:3 cement mortar, rammed into place and compacted by hand sledging. The rest of the pit was then backfilled with sand.

As shown in Figs. 1 and 4, steel grillages were used to give additional support under some of the buttresses and wall angles. Where the buttresses were not built down to the level of the footing course, brackets were inserted beneath such buttresses to transfer their load to the wall and thence to the piles.

The maximum length of the piles was 55 ft., while the average length was about 45 ft. The order in which the piles were jacked down was arranged to give distributed support to the building throughout the whole process of underpinning.

Effect on Structure—The damage to the structure caused by the work was negligible. While the underpinning was in progress, surveys were made regularly to determine any changes in elevation of points located inside and outside of the church. After completing the work, a final survey was made. Comparison of this survey with one made for the Board of Transportation of the city just prior to undertaking the work of underpinning shows a maximum settlement during the work of ½ in., at buttress *J*. Micrometer readings of the width of cracks in the building were also taken at intervals and the changes shown were small.

The underpinning progressed without interfering with any of the regular or special church services and without stopping the afternoon organ recitals. Work was begun in April, 1925, and the first pile was sunk on May 20. The last pile was wedged and loaded on July 15, and on July 30 all work was finished.

Personnel—The author's assistants were Vincent J. McKinnon and Philip D. Joynt.

The contractors were Spencer, White & Prentis, Inc., of New York, whose members are men of long experience on important foundation and underpinning work. Their experience was of great value in expediting the work and contributing original methods. The "pretest" method of testing and loading piles which was used was patented Feb. 20, 1917 by L. White, of this firm.

Would Make Fuel Briquets from London Refuse

A PLAN for converting the "domestic" refuse of "Metropolitan London" into fuel briquets was outlined before representatives of some of the London borough councils on Sept. 16 by the "convener" of the "conference," who was "R. Brown, M.B.E., M.Inst.C.E.," according to the London *Surveyor* of Sept. 18. After the "removal of tins [cans] only," all the refuse would be crushed to a fine powder," briquetted, and then passed "through a bath of oil tar"; or, "if a higher grade fuel" was desired, "coal smudge" would be added. The "convener" stated that "the process has been tested on a large scale" at an expense of £4,000 to himself and friends. Mr. Brown estimates that to briquet the 800,000 long tons of refuse produced yearly (2,670 long tons daily) by "Metropolitan London" would require 150 plant units at a first cost of £450,000. He assumes that the present cost of disposal of this refuse is 8 shillings per long ton (about $1.75 per 2,000 lb.), which under the third of three schemes outlined could be reduced by the fourth year of operation to 5s. per long ton (about $1.08 per 2,000 lb.). Under the first two schemes the boroughs would install and operate the plants, either putting the briquets on the market themselves or selling them to the promoting company. Under the third and recommended plan each borough would do nothing but lease a site to the company at a shilling a year and deliver the refuse to the plant. The company, under a contract running at least ten years, would agree to dispose of all the refuse in a sanitary manner, without permitting any accumulation of refuse or more than three days' output of briquets. The suggested price is to start at the present cost of refuse disposal in any borough and reduce by 1s. per long ton per year until 5s. was reached. Of the 28 London municipalities invited to the "conference" only 8 were represented, although 5 others appointed delegates and two "wanted proposals submitted in writing."

Engineering in the Small City

A series of notes from the field on the Problems and Practices of the Municipal Engineer in the Cities Below 100,000

The Editor Visits the City Engineer

Snapshots of Our Representative Small Cities

CORNER MUNICIPAL BUILDING, ST. CLOUD, MINN.

St. Cloud, Minn.

COUNTY SEAT OF STEARNS COUNTY, and 64 miles northwest of Minneapolis. St. Cloud is situated in three counties, West Side in Stearns County, and East Side in Benton and Sherburne Counties. The city is located on both the Mississippi and Sauk Rivers. It is well known for its large granite interests, and has about forty quarries. Water power is derived from rapids in the Mississippi River. Of manufactured products there are paper, cigars, woolen goods. There are iron-working and lumber mills, foundries and machine shops, brick kilns and flour mills. Repair shops of the Great Northern railway system are located in St. Cloud. Pop. 21,000.

A CONTRACTOR-BUILDER of mills nearly three-fourths of a century ago saw and platted a town at the strategic location of St. Cloud, Minn., 64 miles up the Mississippi from the Twin Cities. The site is at the head of navigation and in the direct line of travel to and from the Red River Valley. John L. Wilson, this contractor, induced a priest to bring German immigrants to settle on his townsite, which he had acquired from a squatter for $100. He laid out the town parallel to the river bank. Today, the main street, 120 ft. wide, runs northeast and southwest and at right angles to the high bridge over the river. To the north and south Wilson had competition from townsite platters who laid their plats with the major points of the compass. All later additions are on the latter basis. Thus, as in so many river towns, the bank alignment was first followed, then discarded, making a belt of sharp angles at street intersections and triangular lots upon which assessments for improvements are a burden. In St. Cloud the city shares the load of these assessments. Wilson picked St. Cloud for other reasons, one of which is good today. The Mississippi, which is confined by 50-ft. banks, drops 5 ft. to the mile here and the Northern States Power Co. has concentrated this head at its door to produce 12,000 hp.

The Townsite—The wooded banks making a lumber industry available for several miles back from the river attracted Wilson and his sawmills. When the trees were cut and the land cleared it added to the contiguous prairie one of the richest of farming soils. Stearns County is one of the first dairy counties in the state. To this agricultural background was added power to develop manufacturing. A third industry was given the city twenty years after its founding (in 1873) when red and gray granite were discovered. Now St. Cloud lays claim to being the second granite producing center of the country, Barre, Vt., being first. Forty companies have manufacturing sheds where the granite, quarried 8 to 10 miles away, is worked up mostly into monumental products. Only two or three companies deal in building stone. With the Great Northern shops employing 1,000 men, the state reformatory, U. S. Veterans' Bureau Hospital of 250 beds, two flour mills, and the defunct Pan Motor Co. plant being revamped to accommodate an auto parts factory and plant making road maintenance equipment, St. Cloud cares well for its 21,300 people who increased in numbers 50 per cent in the last decade. This increase taxes the city engineer's office to keep abreast of public improvements.

Topographically the city is on a flat glacial plane of sand and gravel laid down 50 ft. deep on granite. Trenching, therefore, is an easy problem, machines being used as the gravel is not large and the surface soil holds 10- to 12-ft. trenches open without bracing. Backfill by machines presents no problem since a simple wetting quickly compacts material to a final grade. One particularly notices in driving over the city no unevenness due to pavement settlements or curbs out of line due to frost action. Since a 6-ft. storm drain was built in the west area the water stands about 24 ft. below the surface. Located on a flat plateau along the high river banks the system of sewers is simplified by seven outlets discharging into the river. As yet no thought of collection for disposal is entertained. Unpaved streets of sand and gravel worked over with two tractors hauling graders are excellent so long as they are moist, but require sprinkling and constant attention. With granite and sand at hand for aggregate the best of concrete can be made, but at present a 2-in. bitulithic on 5-in. base of 1:2:4 concrete is popular.

The glacial underground material and river in its canyon-like slot are directly or indirectly the principal distinctive physical characteristics by which the engineer gages his designs. Building foundations and all underground works are stable. One of the two city bridges over the river has been taken over for maintenance by the State Highway Commission and the other will soon be transferred, so the bridge feature will soon be out from under the city. Painting and a new deck to replace the wood block floor are being deferred in the hope that the state will take over the bridge soon.

City Engineering—M. B. Lang, city engineer, one engineering assistant, two rodmen and two to five non-technical inspectors make up the engineering staff, taking care of all construction of paving, sidewalks, curbs, sewers and water mains. St. Cloud has had the commission form of government for twelve years, a mayor, a commissioner of financial accounts and a commissioner of streets and public improvements. The commissioners are elected every four years. All other employees are appointed. Mr. Lang reports to the last-named commissioner and in addition to the above duties makes assessment rolls for all improvements, all of which are charged to the property owner on a front-foot basis. St Cloud has a $200,000 bond indebtedness only, few things being financed that way. Improvements are initiated by the commission and put through without court action after six hearings. No improvements have been knocked out so far, although any citizen has the right of court appeal. Payments may be made in from 1 to 10 years, the term being deter-

mined by the commission. Like most city engineers, Mr. Lang finds difficulty in keeping ahead of the job with designs. Improvements are often authorized in May and scheduled for June lettings, loading him and his assistant with rush plans.

A special engineering problem ahead of St. Cloud is its water supply. The raw river water is chlorinated and purveyed, but no one drinks it. Well water, hard in character, is obtainable 20 to 60 ft. below the surface and householders have driven wells of their own or carry water from community wells, of which there is usually one in every block. At least a majority of the water users are satisfied with such procedure. Sixty per cent so indicated this spring in an informal post card referendum. On the other 40 per cent, 60 per cent want filters and the remainder a well-water system developed and softened. A 40-lb. pressure is now maintained but this is boosted from 80 to 100 lb. during fires, though the fire department has pumpers. As there are no buildings over five stories the city is well protected. Though the consumer gets no culinary water, all but 200 taps of the 2,500 services are metered and pay 20c. per 1,000 gal. The average consumption is 1.3 m.g.d. rising to a maximum of 5 m.g.d. in summer when lawn sprinkling is at its height. Consulting engineers desirous of putting in a filter and well-water companies guaranteeing a sufficient supply are continuously "making" St. Cloud. At present the consultants seem to be gaining more headway than the well-water people. There are 43 miles of 4- to 16-in. mains and 40 miles of sewers to carry off the spent water.

Paving, aside from that in the business district, is a comparatively recent activity. The yardage is 236,000 sq.yd. of bitulithic, 78,000 of concrete and 30,000 of creosoted blocks. About 37 blocks mostly bitulithic costing the property owner $3.12 per sq.yd. on a bid of $2.89 per sq.yd. outside of excavation were done last year and about the same program is under way and planned for the future. All utility underground conduits are required to be put in before paving is started to reduce cuts to a minimum. Curbs go in with the sidewalks and are now entirely of concrete battered on the face 1½ in. and curved at the base where combined with the gutter. In most cases curbs only are set, the pavement abutting the curb face. While no laws make requirements about buying patented pavement the commissioners have absolute power of choice of kinds. Usually several types are called for in bids.

Maintenance of the wood block is done with ¼ gal. per square yard of Tarvia B. put on every second year by a contractor at 10c. per gal. After this coating absorbs for 24 hours, sand spreaders sprinkle 1 cu.yd. to every 300 sq.yd. of pavement. A man with broom and shovel follows to make sure all parts are evenly covered.

Curb faces rise 7 in. above the pavement, the parking has a slope of 2 to 2½ in. to the sidewalk which has a slope of ¼ in. to the foot for drainage.

Street cleaning previously done inadequately by five white wings is now done every night in the business district by a mechanical sweeper. Two white wings still patrol the streets during the day. The residence district is covered by the sweeper twice a week. Inspection indicated clean streets everywhere. Costs with the new sweeper are being recorded but are not yet available. Two tractors and several horse-drawn wooden plows are used to clear off snow. The street car company sweeps its 9-ft. strip as well as paves it originally. Street cleaning and other city equipment is stored and maintained at shops recently built after designs of the city engineer

Garbage is collected by private scavengers who haul it to the country where it is fed to hogs. The health officer has an inspection service to direct it.

Alleys in the business district only are paved. Concrete with a concave section draining to the center is the usual design.

Traffic is handled entirely by the police, though Mr. Lang laid out the 60-deg. parking strips painted in yellow which give a maximum number of stalls on wide streets without car tracks. On streets with car tracks parallel parking is the rule. Three automatic stop-and-go signs of the post type that fall over when struck are set in the center of three of the most congested crossings.

Arc lights are set by the city in the residence districts at every other intersection, 24 ft. in the air. The public service company maintains them. Twenty per cent of the cost of a white way was paid for by the city, the remainder by the property owners. It consists of two 220-cp. lamps on 12-ft. posts spaced four to a block of 264 or 330 ft.

Reflection as to St. Cloud and its engineering a week after visiting the city brings this point most vividly to mind: How long can a fine city of this kind go on obtaining its drinking water supply from individual wells without experiencing an epidemic? If the epidemic does not come how long will the citizens put up with the well water inconvenience?

In general, St. Cloud is waking up to the need of better engineering works, paving, sewers, added parks, water-works and other improvements, and Mr. Lang is ready to meet the situation as fast as public sentiment opens the pocket book.

Engineering Work

Bituminous Surface for Concrete Paving

By Troy Carmichael
City Engineer, Helena, Mont.

IN OUR maintenance of concrete pavements we have varied somewhat from common practice and have patched cracks, joints and holes with a plant-mixed bituminous mixture which is giving very good results. Some of our patches have been down two years and with the exception of a crack opening up over the expansion joints in the concrete pavement show no signs of wear. We use what we call a "3-bin" mix of approximately the following percentages:

Passing	Retained on	Percentage
¾	¼	25-50
¼	No. 10	15-30
No. 10	..	30-45
Bituminous Cement		7.5-11

The sand passing a No. 10 is graded as follows:

Passing	Retained on	Percentage
10	40	15-50
40	80	20-55
80	200	15-40
200	..	5-15

In case the crack is small the larger material is raked out on the street and wasted. This waste is very slight, however.

Of the Small City

In resurfacing worn-out brick pavements we have noticed that other resurface jobs in the west and northwest do not compare favorably with our work here and in every case we have found that extra binder was sparingly used in trueing up the old brick surface before the application of the wearing surface. Too much emphasis cannot be placed on this feature of salvaging worn-out pavements of any sort. It is very easy for an engineer to get economical and try to save money by just filling up the minor depressions with the wearing surface mixture, but it simply will not produce good results.

Even compression in asphaltic pavements is necessary to secure even wear and nothing but unsatisfactory results will be obtained by trying to roll a pavement that is 2 in. thick in one place and 3 in. thick in another.

In making an estimate it is impossible for an engineer to make better than a guess as to how much extra binder will be used and the contractor finds it equally difficult to figure labor costs on a shovel full here and a wheelbarrow full there; consequently he bids high. The engineer is quite apt to be sorry for every nickel he saves because under traffic the finished surface will follow the irregularities of the base.

How the Work of City Engineers and Consultants Should Dovetail

CERTAIN new thoughts and old ones put in succinct form on the functions of the engineer in municipal activities are contained in an article by Paul Hansen in the July-August *Illinois Municipal Review* the organ of the Muncipal League of the state. He puts it this way:

Skill, experience and personnel for handling certain types of problems including surveys, preparing plans and specifications, supervising construction and operating the completed works constitute the equipment that engineers can bring to bear on a project. Agreements with an engineering firm should call for the service of such of the equipment as the engineering firm has and the city lacks. The city officials should handle all work that they can do equally well or better. In municipalities that have city engineers most of the necessary surveys can be made by them and they can otherwise contribute to the carrying out of the work. In some instances they can prepare plans and specifications under the general guidance of the outside engineers but generally speaking a city engineer's office is too fully occupied with routine matters to undertake these additional activities. On works of very large size requiring several years of planning and several more years of construction a special engineering staff may advantageously be organized for the work in hand and placed under the general supervision of the city engineer but under the more direct guidance of outside engineers acting in a consulting capacity. In still other cases the personnel of the special engineering staff may be such as not to require the continuous supervision of outside engineers but may get along very nicely with occasional outside help to pass upon special questions. The outside help may be either a single well qualified individual or firm or may consist of a group or commission of experts.

The work of engineers on municipal undertakings may generally be divided into four phases: (1) preliminary investigations, (2) preparation of detailed plans and specifications, special assessments, ordinances, advertising for bids and awards of contracts, (3) supervision over construction, and (4) supervision over operation.

The value of preliminary investigations is too little appreciated because the character of such investigations is little understood by the layman official. Gathering of data, comparative project studies and comparative estimates of cost are not thought of and it is presumed that the first step in the procedure is getting out the "blueprints" and specifications. As a matter of fact, the engineer at his best is primarily a painstaking co-ordinator of facts, using his skill, training and experience, first in gathering the pertinent facts, second in arranging them and interpreting their significance, and third in formulating a plan that will represent efficiency and economy. The actual reduction of the plan to paper in the form of drawings and specifications is of secondary importance, though essential for the proper completion of the project. If the preliminary engineering work is well done and properly presented it should make clear to the official and the citizen the relative merits of various possible ways of solving a given problem and should present a clear picture of the character and extent of work recommended.

Activated-Sludge Process Advised for Elyria, Ohio

THE activated-sludge process of sewage treatment, with disposal of the sludge by lagooning, has been advised in a report made by George B. Gascoigne, consulting sanitary engineer, Cleveland, Ohio. A plant for serving a population of 37,500 persons at the start and 100,000 persons ultimately is proposed. Pre-treatment of large quantities of pickling liquor wastes before they enter the city sewers is also proposed. The activated-sludge process was chosen rather than Imhoff tanks and trickling filters on the assumption that for local requirements the two would be on a par as regards ability to produce satisfactory continuous operating results, land requirements for extensions and head requirements, but Mr. Gascoigne concluded that from the standpoint of isolation and absence of odors the activated-sludge process had a distinct advantage. As regards simplicity in operation, the advantage would be somewhat on the side of the tank and sprinkling filter plant. Also on various bases of comparison of cost, the tank-filter combination was the more advantageous, as the accompanying table shows. The primary reason for recommending the activated-sludge process with lagooning was that a suitable site for a tank-filter plant was not available, but that one could be had for the activated-sludge process with plenty of land for lagooning in a truck garden district. While the lagooning of the sludge requires some outlay for land, pipe lines and pumping equipment, the upkeep is estimated to be relatively small.

COMPARATIVE ESTIMATED COSTS OF SEWAGE-WORKS FOR ELYRIA, OHIO

Item		Imhoff Tank and Trickling Filter	Activated Sludge
Construction cost, including land		$490,000	$350,000
*Annual charges, per cent:			
Bond retirement	4	19,600	14,000
Interest on bond	2.34	11,370	8,190
Operation		12,800	28,660
Repairs and Renewals:			
Tank—filter	0.5	2,430	...
Activated sludge	2.0	...	7,000
Total		$46,300	$57,850
Cost per m.g. of sewage treated		$42.28	$52.83
Construction cost per capita (37,500)		13.07	9.33
Annual cost per capita (30,000)		1.54	1.93

* Based on treating an average of 3 m.g.d. during the next 15 years, or serving 30,000 persons at 100 g.p.d.

The proposed plans are now before the State Department of Health for approval. James A. Hewitt is director of public safety and service at Elyria and J. M. Powell is city engineer.

Furnishing Concrete by a Strength Specification

A Practical Application of the Water-Cement Ratio Theory With the Aid of a New Scale-Weighing Device Which Fixes That Ratio for Each Batch

One of the disputed points of the progress report of the 1921 Joint Committee on Concrete and Reinforced Concrete was the famous alternate clause 28, which provided that "the contractor shall use materials so proportioned and mixed as to produce concrete of the required workability and strength." This provision for specifying concrete solely on strength without regard to its constituent proportions was so vigorously attacked in the discussion that the clause was abandoned. However, some contractors and engineers are experimenting with the possibilities of specifying concrete by strength alone. The accompanying two articles are descriptive of the work along this line being done by John G. Ahlers, a New York contractor.

Mr. Ahlers' theory is given in the first article; the device by which he carries out the theory, in the second. In brief, the theory of this method is that the strength of the concrete being a function of the water-cement ratio, any required strength can be guaranteed by insuring the proper ratio in the mixer, adding thereto aggregate in sufficient quantity to produce a workable concrete. Economy, on the other hand, may be effected by proper grading of aggregate. The owner, through his engineer, is interested only in strength; so he specifies that alone, leaving to the contractor, who is interested in economy, to provide the proper strength by an established water-cement ratio and to grade and proportion his aggregate to suit his own ideas of economy. How Mr. Ahlers has been doing this to his own satisfaction is described below.

* * *

Water-Cement Theory as a Fact in Field Control of Concrete

Specifications Simplified, Strength Assured—High Economy Possible by Proper Grading of Aggregate

By John G. Ahlers

Barney-Ahlers Construction Corporation, Industrial Builders, New York City

WE ARE on the verge of new conceptions in designing and controlling concrete mixtures, and I predict that within a few years most of our concrete specifications will be entirely changed. However, even among engineers who have studied the problem, there are differences of opinion, and this article is not presented in a spirit of being the only grasp of the subject. It is put forward with the hope that it may simplify specifications for concrete and enable every engineer to apply the new theories developed at Lewis Institute in ordinary field procedure.

The underlying idea in this new way of controlling concrete is to eliminate the age-old contention between the engineer and the contractor, namely, that of proportions of cement to aggregate. This is easily done if we approach concrete design from the angle of keeping entirely apart the matters of strength and economy or yield of mixture. If we can write such a concrete specification we can have harmony and co-operation, and the engineer and contractor can concentrate each on his particular field in the construction work. We will at the same time eliminate controversy as to the use of ready-mixed material against separate sand and gravel so that the engineer will never question in the future the use of ready-mix.

To accomplish our aim we must accept the water-cement ratio theory as a fact. There have been sufficient data gathered and published on this subject to convince most engineers; and, proceeding on this basis, we can divide the problem of control of concrete into two parts: (1) First and foremost, strength (controlled entirely by water-cement ratio) and (2) economy (controlled entirely by grading and density of aggregate).

Strength—The engineer's problem and demand is strength. If he can secure strength at a certain age and during mixing a good, easy-working concrete, no one will deny him his request since it is reasonable. If he is sure of his strength, he can design his structure closely and not require abnormal factors of safety.

One thing, and one thing only, controls the strength of concrete and that is the water-cement ratio so long as the same cement is used throughout and the same chemically composed aggregate. The grading of the aggregate and the ratio of fine to coarse can be varied as much as one pleases but so long as the final mixture is workable, the concrete will remain of the same strength when the water-cement ratio is kept constant. (See Portland Cement Association bulletin, "Design and Control of Concrete Mixtures.") For this reason the engineer should confine his effort to demanding a definite proportion of water to cement. In line with this demand he should: (a) Arrange a system of control at the mixer to obtain this definite proportion; (b) check up very early in the contract as to what strength he is obtaining for a fixed water-cement ratio by mixing some trial batches; (c) see that his aggregate is sound. Let him specify the water-ratio for, say, 2,000-lb. concrete that he has found from his trial batches to be necessary, and insist that no more than such an amount of water be used per 94 lb. of cement, and let his field man follow this up. Every contractor will co-operate with such a request, and if he is let alone on his proportions, tests will show better strengths than ordinarily expected in concrete construction.

Economy or Yield—Economy is the contractor's problem and demand, and at times, unfortunately, all he is interested in. No one will deny him his request, however, if he does not sacrifice strength. He should be allowed every latitude to obtain a high yield by grading his aggregates so that the minimum amount of cement will give him the proper strength. The only limiting factor should be his ability to study the subject and apply it in practice, that is, to judge the aggregate. When the contractor has the water-cement ratio fixed so that he cannot vary the amount of water and cement that is put into each charge of his mixer, he will immediately interest himself in his one remaining source of economy—that of adding a large amount of aggregate to each batch so as to obtain a good yield. He can do this in two ways: First, by simply adding a large

amount of aggregate to each batch regardless of grading, being limited only by the workability of his concrete, by his ability to ram and tamp it into good position in the forms, and by his desire to have a smooth surface on the removal of the forms; second, he can obtain higher yield by careful grading of the aggregate obtained by using the largest possible size of stone and having all voids filled by smaller sizes of aggregate and the minute spaces by coarse and fine particles of sand.

The problem of grading is not as difficult as one

FIG. 1—WATER-CEMENT REGULATOR IN USE
The mixer is below the level shown.

might think. Simple tests that can be made in any contractor's office will solve it for him. Let him take his various samples of both coarse and fine or mixture, dry them thoroughly and then by a little experimenting, mix them together and see which proportions give the heaviest resulting mixture per cubic foot. He can even take a smaller measure than a cubic foot—a quart measure might do—and weigh the samples on a small scale. If he knows just how much of each sample is present in the mixture giving the heaviest combination, he is perfectly safe in going ahead with such proportions in the field and can be reasonably sure that this will give him his greatest yield. Of course, he may go further and employ an engineer to work out for him the same thing scientifically by the use of sieve analysis, fineness modulus, and all the other methods known, but these only figure on paper what trial may give him, namely, the densest weight per cubic measure.

General Conclusions—Perhaps the average engineer or contractor working with concrete will find the above too simple. And perhaps he will mention all the numerous obstacles that are sure to come up in attempting to control the water-cement ratio on a mixer plant. It is possible however that such men have not tried to work this control out in the field. The writer maintains it is practical, and has actually weighed the cement and the quantity of water going into each batch by a simple device balancing one against the other, and this throughout an entire building operation. *(This device together with the job procedure used in its operation is described in the other of these two articles dealing with a practical application of the water-cement ratio theory.*—EDITOR.)

On three building operations now under way, concrete is being controlled by this method with excellent uniform results, and the contractor's organization is very quickly adapting itself to such a system of control. Even further, the superintendent and foreman are requesting its use as giving more uniform concrete to work with. The adjustments for the amount of moisture contained in the aggregate are rather simple and surprisingly uniform, with variations much smaller than those found under present methods of controlling concrete.

The principal difficulty in accepting the new way of designing and controlling the strength of concrete will probably come from having to throw away all our old notions of 1:2:4 concrete—our fixed specifications that confuse slump, yield, mix and strength. Nevertheless, we are apt to move forward and anything better will in the end find its way.

So to repeat the prediction stated in the beginning: Within a few years design of concrete will be considered a very simple matter. It will be this: First, the engineer will use a fixed water-cement ratio for any given strength—and get it; second, the contractor will, after fixing his water-cement ratio, be let alone and allowed to add all the sound best-graded material he possibly can and still work his mix. Let us hope that all professional and practical people will help bring that happy day to pass as soon as possible.

* * *

Scale-Weighing Device Applies the Water-Cement Ratio Theory

Ratio of Volumes of Water and Cement in Mixer Charge Kept Constant for Any Given Setting of the Beam-Scale

THE MECHANICAL device for controlling the water-cement ratio that is being used by John G. Ahlers on several building operations in and around New York City consists essentially of two hoppers, one for the cement and one for the water, mounted on the opposite ends of a beam structure that is supported on a knife-edge fulcrum between the hoppers. Results are obtained from this device by balancing the hoppers in the desired ratio.

The water-cement ratio theory is that for given materials and conditions of manipulation, the strength of the concrete is determined by the ratio of the volume of mixing water to the volume of cement so long as *workable mixtures* are obtained. The required ratio of these volumes for the mix to be used is fixed by a proper setting of the concrete strength regulator, as the device is called, in which the respective weights of the volumes are determined, and the principle utilized that equal moments about the fulcrum produce a balance of the beam structure. (Water lb./cement lb. $= a/x$, Fig. 2). The regulator provides for varying the water-cement ratio by adjusting the length of arm x by means of a long screw. Adjustments for daily variation of water in the aggregate are made by adding or removing weights on the cement hopper equivalent to such minor changes. The amount of these weights is checked daily by drying several representative samples of the aggregate and determining the average per cent of moisture. Since all references are made to bone dry aggregate and these daily adjustments made accordingly, it is possible to ignore absorption.

Job Procedure—The contractor's instructions to his field forces state that to understand and use the concrete strength regulator, the findings of the Lewis Institute on the water-cement ratio must be taken as facts. This entails the acknowledgment of the existence of strength curves based upon some such equation as $S = 14000/7^x$, in which S is the compressive strength at 28 days and x is the water-cement ratio W/C. The constant 7 is determined for definite conditions of test and of course changes for any variations in these conditions; for this reason, there is an equation for every set of job conditions. Since the equations differ only in this constant denominator, their curves are all parallel (Fig. 3), and with the determination of one point on any curve, the entire curve can be drawn parallel to one of these known curves.

The first step in the job procedure is therefore to determine the strength curve depending upon the quality of cement and the kind and cleanliness of aggregate to be used. This is accomplished by making several standard test cylinders using a W/C of unity, to which mix has been added an amount of aggregate that makes it workable to about job conditions, by testing these cylinders at 7 days and by computing their estimated strength at 28 days from the equation $S_{28} = S_7 + {}_{20}\sqrt{S_7}$. There is thus obtained a definite compressive strength for a W/C of unity which represents one point on the strength curve which can now be drawn parallel to one of the known curves in Fig. 3. In preparing the aggregate for making these test cylinders, it is thoroughly dried and the average percentage of moisture content determined.

The job curve and moisture content having been determined, the next step is the setting of the regulator. In describing the computations involved, it is necessary to assume a strength curve and a certain required 28 day strength on this curve. Assume, therefore, that $S_{28} = 2050$ lb. per sq.in. for W/C = unity, which causes the job curve to practically coincide with curve A of Fig. 3. Now assume further that the engineers' requirements from the contractor are 1800 lb. concrete at 28 days. Concrete of this strength corresponds on curve A to a W/C of 1.05. For a ½ yd. mixer, 2 cu.ft. of cement per charge is required so that $W/C = \frac{2.10 \text{ cu.ft. water}}{2 \text{ cu.ft. cement}} = \frac{15.75 \text{ gal. water}}{2 \text{ cu.ft. cement}}$. Also for a ½ yd. mixer, 1300 lb. of aggregate comprises an average charge and assuming a 3 per cent moisture content gives a correction factor of 39 lb. of water (1300 × 3 per cent) or 4.8 gals. to be subtracted from the amount of water that is theoretically required. The net amount of water for each mixer charge is, therefore, 15.75 gal. − 4.8 gal. = 10.95 gal. The tank now being filled with this amount of water, 2 cu.ft. of cement are put into the cement hopper and arm x of the regulator adjusted until the beam balances. The over-balancing of the beam automatically shuts off the water, and the charge

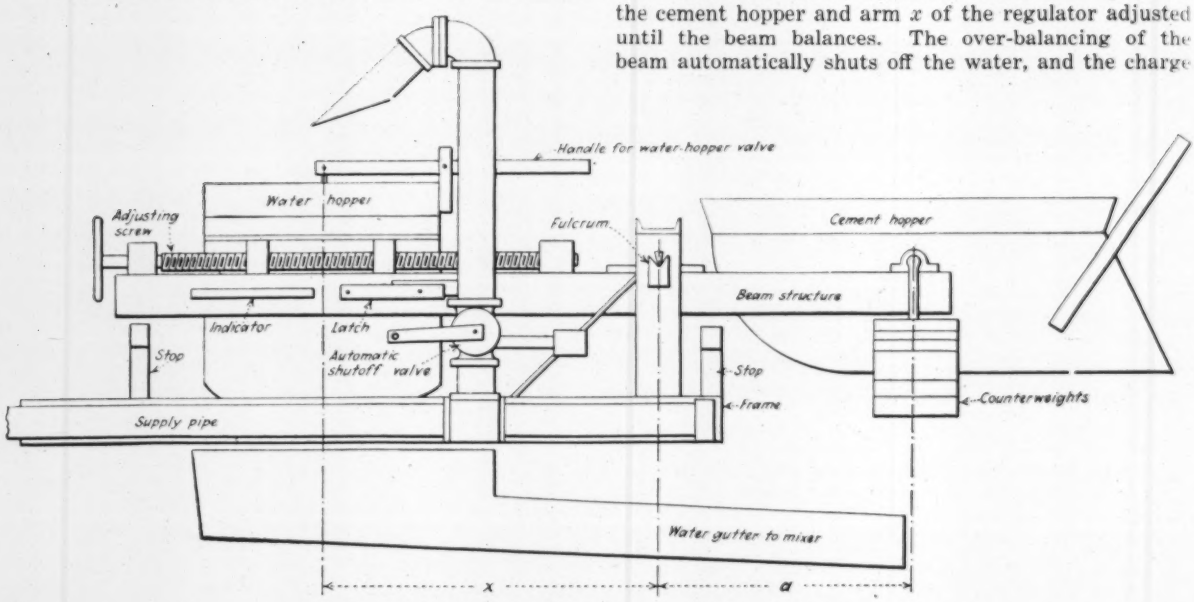


FIG. 2—DETAIL SKETCH OF WATER-CEMENT REGULATOR

of cement and water is ready to be emptied. As shown in Fig. 1, mixed aggregate, in amount sufficient to leave a workable mix, is emptied with the cement and water into the mixer below, thus completing the charge. After the regulator is once set, the job can continue with a definite and fixed water-cement ratio by putting in successive batches of cement, opening the water valve, letting the beam over-balance and shut off the water, and discharging into the mixer along with the aggregate.

Test Methods and Results—During the progress of the work tests have been made on cylinders cast from different consistencies of mix and varying ratios of water to cement. The objects of the tests were three in number:

1. With a constant water-cement ratio, to show that the strength of the concrete was practically constant with varying amounts of aggregate within workable limits.

2. With a constant water-cement ratio, to show that the character of the aggregate had little effect on the strength.

3. With a variable water-cement ratio determined by reference to a curve, to show that the strength could be controlled as desired.

The water-cement ratio was automatically maintained at the desired value by means of the regulator device.

To show the first object, four variations in the amounts of aggregate were made. Arranged from the driest and leanest to the richest and wettest mix, they were as follows:

1. Driest workable mix. 4½ barrows of mixed aggregate, 2 bags cement, water-cement ratio unity, slump 5 in.

2. Job conditions. 4 barrows mixed aggregate, 2 bags cement, water-cement ratio unity, slump 6 in.

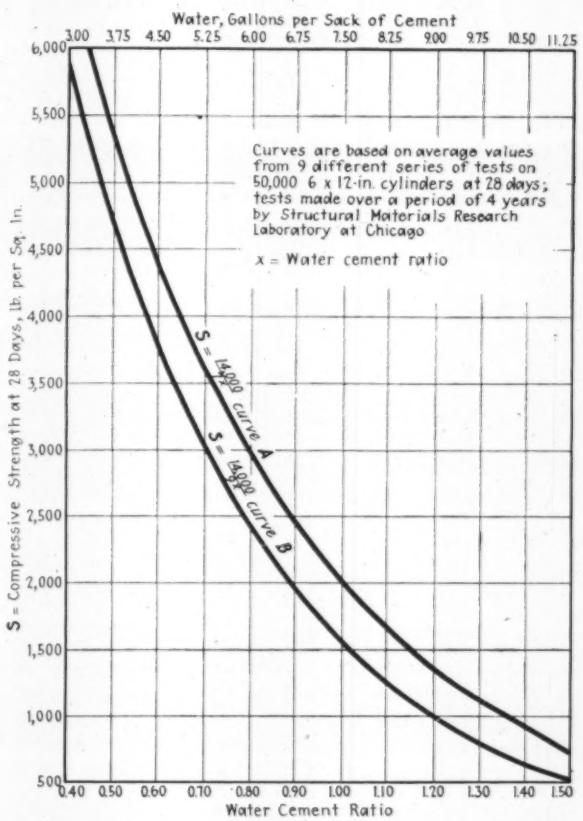

Water, Gallons per Sack of Cement
3.00 3.75 4.50 5.25 6.00 6.75 7.50 8.25 9.00 9.75 10.50 11.25
6,000
5,500
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
S = Compressive Strength at 28 Days, lb. per Sq. In.
Curves are based on average values from 9 different series of tests on 50,000 6 x 12-in. cylinders at 28 days; tests made over a period of 4 years by Structural Materials Research Laboratory at Chicago
x = Water cement ratio
S = 14,000 curve A
S = 14,000 curve B
0.40 0.50 0.60 0.70 0.80 0.90 1.00 1.10 1.20 1.30 1.40 1.50
Water Cement Ratio

FIG. 3—JOB CURVES GIVING RELATION WATER-CEMENT RATIO TO STRENGTH

Each curve is determined from definite conditions of test. The lower curve may be considered as a reliable indication of the minimum strength to be expected where the concreting operations are not under rigid control.

3. Richer and wetter mix. 3½ barrows mixed aggregate, 2 bags cement, water-cement ratio unity, slump 8 in.

4. Richest and wettest mix. 2½ barrows mixed aggregate, 2 bags cement, water-cement ratio unity, slump 9 in.

To show the second object, sand was mixed with the mixed aggregate in the proportion of 1½ barrows of sand to 2 barrows of mixed aggregate, or a total of 3½ barrows. These results should be compared with those of No. 3. The water-cement ratio was unity. The slump was 8 in. This test is marked No. 5.

To show the third object, the water-cement ratio was reduced to 0.90. 3½ barrows of the aggregate were used and the results should be compared with No. 3. The slump was 6 in. This test is marked No. 6.

In the following table the numerals correspond to the test numbers immediately above. Letters have been added to designate each cylinder.

28-DAY TESTS ON 6x12 IN. CONCRETE CYLINDERS

Cylinder	Weight, Lb. per Cu. Ft.	Compress. Strength Lb. per Sq. In.	Cylinder	Weight, Lb. per Cu. Ft.	Compress. Strength Lb. per Sq. In.
Driest Mix.			Job Conditions		
1A	147 7	1756	2A	146 5	1990
B	146 5	1745	B	148 4	2065
C	147 8	2260	C	146 4	2090
D	146 5	1780	D	146 5	2170
E	147	2060	E	145 5	1735
Average		1921	Average		2010
Richer and Wetter Mix.			Richest and Wettest Mix.		
3A	145 2	2385	4A	146 7	2420
B	146 2	2505	B	147 2	2450
C	145 8	2950	C	150 3	1980
D	146	2270	D	149 7	1883
E	146 3	2600	E	148 4	2160
Average		2542	Average		2179
Sand Proportion Increased			Water-Cement Ratio, 0 90		
5A	132 7	2303	6A	143 2	2880
B	134 8	2380	B	143 2	2620
C	135 4	2130	C	148 2	1950
D	135 8	2360	D	143 4	2720
E	133 6	2420	E	141 3	2575
Average		2319	Average		2549

The results of these and other tests have confirmed the practicality and efficiency of the regulator to the contractor's satisfaction and he is extending its use to other of his construction operations. In addition to these tests weekly reports are required from the field forces covering such essential points as results of trial batches, moisture content, test specimens made, test specimens broken with results predicted for strength of concrete in the structure, concrete poured, cement factor and yield.

The regulator was devised by Mr. Ahlers. Patent on it has been applied for.

Mock Trial to Aid Jury-Room Design

In order that as nearly perfect a combination of good light, good ventilation, acoustical properties, comfort, convenience, and arrangement of principals may be secured as possible, something believed unique in court-room design is to be tried out in the new court house in St. Louis, Mo. E. R. Kinsey, president of the Board of Public Service, under whose supervision grouping of new and old public buildings around a memorial plaza is to be undertaken as part of the recent $87,000,000 bond issue for St. Louis public improvements, asserts that a practical plan will be adopted to insure the best possible arrangement in the 24 court rooms. It is proposed to utilize a large floor and inclose an area thereon the exact size of the proposed court room. Theatrical properties will be borrowed and the court room will be set up exactly as planned. Judges, lawyers, a court stenographer, clerk, sheriff, and a volunteer jury will be asked to co-operate in a try-out of the proposed plans. If the judge's desk seems improperly placed it will be moved; the jury may be grouped differently and moved about; the witness and the stenographer may be shifted; but when an arrangement has been arrived at which seems most practicable and workable, the plan of the court room will have been perfected. It will remain simply to measure up the result and incorporate it in the plans which already have been worked up showing the proposed arrangement.

American Society of Civil Engineers Meets in Canada

Hydro-Electric Problems, Particularly the Export of Canadian Power, and New Methods of Proportioning Concrete Mark First Meeting Outside the United States in Twelve Years

FIVE times since its first meeting in 1869 has the American Society of Civil Engineers met outside the United States: in 1881 at Montreal; in 1897 at Quebec; in 1900 at London; in 1907 in Mexico City, and in 1913 at Ottawa. The sixth excursion outside the country in the 57 years was last week at Montreal. Over 400 members and guests were registered at the meeting, which started Wednesday, Oct. 14, and carried through Friday, Oct. 16, which was devoted to an excursion to the St. Maurice River, where the various power plants of the Shawinigan Water & Power Co. were inspected. The Canadian members of the society and particularly the Montreal Branch of the Engineering Institute of Canada were exceedingly thoughtful in their entertainment of the visitors. There was a well attended luncheon on the first day, a novel smoker in the evening of that day, and a dinner dance on Thursday night. In addition, on Thursday noon, through the courtesy of the Cunard Steamship Co. and of the White Star Dominion Line, luncheons were given on two of the large trans-Atlantic liners lying at their docks in Montreal Harbor.

In the general sessions of the meeting the main topic was hydro-electric development in Canada. This was opened by a description of the work of the Quebec Streams Commission, by O. O. Lefebvre, chief engineer of that commission, and of the Hydro-Electric Power Commission of Ontario by Frederick A. Gaby, chief engineer of that commission. These descriptions served to acquaint the members who did not already know about Canada's governmental power developments with the two major and differing forms of hydro-electric control operating in the respective provinces of Ontario and Quebec. Ontario has the governmental system highly developed in the Hydro-Electric Power Commission, a group of municipalities operating municipally owned power under the supervision of a provincial board. Quebec, on the other hand, has not resorted to governmental or municipal ownership, but has emphasized the government's part in stream control by developing reservoir sites and building dams thereon leasing rights to the power to private companies.

Exporting Canada's Power—The major controversial discussion of the session was developed by a paper by Ira W. McConnell, vice-president of the Dwight P. Robinson Co., of New York City, entitled "Some Economic Aspects of Hydo-Electric Development in Canada." In effect, Mr. McConnell argued that Canada for her own good would be wiser to allow the development of her numerous water powers for export purposes over a limited term of years, rather than to set up the embargo against export that seems to be the present governmental policy both federal and provincial.

Mr. McConnell's paper included extensive quotations of the power resources of Canada, taken from various reports. The one which was discussed mostly by succeeding speakers was to the effect that available and developed water power in the provinces of Ontario and Quebec at ordinary minimum flow was about 11,000,000 hp., 24-hr. power at 80 per cent efficiency. Other statistics were given to show the close interweaving of the commercial relations of Canada and the United States and the relative closeness of the ups and downs of imports and exports from respective countries. Mr. McConnell concluded that figuring both by the analogy of the development of the United States and by the prospective development of population and wealth in Canada, it would be possibly 75 years before Canada could herself expect to be able to use her full development of water power and that it would be advantageous to her to have the first cost of development taken care of by the returns from exports of power over a limited period reaching toward that time when the country would need all of its own power. Finally, he argued very strongly against the theory that a contract made between the United States and Canada today, terminating a power export at some given time in the future, would not be terminable at that future time.

Discussion on the paper was started by H. G. Acres, consulting engineer and formerly hydraulic engineer of the Hydro-Electric Power Commission of Ontario. Mr. Acres started his remarks by saying that there were some questions in this world which had gotten beyond the stage of argument into the stage of conviction, and he considered the export of power from Canada to be one of these. He further felt that Mr. McConnell's paper was a citizen's propaganda and not an engineering society discussion, and that it was not proper to discuss a matter of this sort before an engineering society. He, therefore, said that he would not discuss it as an engineer but as a citizen. He questioned the theory of Mr. McConnell that Canada could not use its surplus power until it had 100,000,000 population. He thought that the nearer figure would be 50,000,000. He said the real substance of the question was whether hydro-electric power was a commodity or not. In his opinion it was not a commodity but an agency from which commodity and population can be created. The United States, he thought, needed power to maintain population; Canada, to create population. That latter was Canada's great and commanding need. The commercially available hydro-electric power in Canada, he said, was not greater than its early needs. He thought that if there was a proposition to export power from Labrador, say, where there was no chance of its being needed very soon by Canada, some agreement might be reached, but he did not think that power should be exported from either Quebec or Ontario. The question in his mind is, assuming that Canada could reclaim the power at the end of a contract period, could it reclaim the assets that that power would build up in a foreign country if it were exported to that country. His answer to that emphatically was no.

The second discussion was by Julian C. Smith, vice-president and general manager of the Shawinigan Water & Power Co. of Montreal. Mr. Smith questioned Mr. McConnell's statement that the water powers of Canada were going to waste. He said as long as no money was being spent on these powers, there could be no waste. He felt that the Canadian people were slowly developing some relief from the incubus of American coal; that at

some early time Canada would be able either to make better arrangements for the use of British coal or would develop its own remote coal resources. The fallacies in Mr. McConnell's argument, according to Mr. Smith, are, first, that there are huge surpluses of potential power in Canada. He said that instead of 11,000,000 hp. being available in Ontario and Quebec, within the developable area there probably was not 6,000,000, of which 3,000,000 was in the St. Lawrence. Second, that it would be good business to export power. This he specifically denied on the same basis as Mr. Acres denied it. And, third, that it would be reclaimable. He apparently felt that once power was contracted for in the United States, such influences would be brought to bear at the end of the contract period as to make it impossible for Canada to get it back.

F. A. Gaby, chief engineer of the Hydro-Electric Power Commission of Ontario, reiterated most of the arguments of Mr. Smith. He added that over 50 per cent of the usable hydro-electric power in Ontario was now used instead of the 15 per cent cited by Mr. McConnell. He also claimed that during the war Canada tried to get back the power which was being sent across the border on a yearly-lease basis, but that such powerful influences were brought to bear at Ottawa (presumably by the government at Washington) that such reclamation was not possible.

Norman R. Gibson, hydraulic engineer of the Niagara Falls Power Co. of Niagara Falls, N. Y., said that he had no convictions on the question of the export of power. He felt, however, that Mr. McConnell's analysis of the potential needs of Canada in the matter of power, based on a per capita consumption in the States and in existing parts of Canada, was not exactly a true measure of the need of power. He cited the case of Niagara Falls, N. Y., which uses power in a far greater per capita ratio than the whole country or the State of New York because of the concentration there of electrochemical industries requiring a relatively small number of men to operate them. Mr. Gibson thought, however, that there should be the possibility of arranging for the financing and construction of hydro-electric plants in Canada for export purposes on the basis of the so-called "financing contract" which always has to be made in a big new plant to start the development and to start population growth.

George A. Orrock, consulting engineer, New York City, said that he had heard in the discussion no mention whatever of the all-governing matter of price. He said that until it was demonstrated that Canadian power could be sold in the States at some more favorable price than apparently is now possible, he did not see that there was very much need to be concerned over the export of power from Canada. With the great developments in steam-power electric production, the economies of hydro-electric production were apt to vanish. So far as he had seen, all the Canadian proposals that had been made were just about on the ragged edge of economy.

In ending up the discussion, Francis C. Shenehon, consulting engineer, Minneapolis, begged to differ emphatically with Mr. Acres in his contention that the discussion of such a matter as this was not a fit subject for an engineering meeting. He felt that the economies of power even if it involved international questions was quite obviously a matter for the public consideration of engineers.

Divisional Meetings—Thursday afternoon was devoted to three simultaneous meetings of the technical divisions. Only a few people attended the Sanitary Engineering Division, where a paper by F. E. Field on the water supply of Montreal, Canada, was read and a symposium on grit chamber practice entered into by F. A. Dallyn, director of sanitary engineering, Division of Health, Ontario, and George P. Gascoigne, consulting engineer, of Cleveland, Ohio. The discussion of the papers was led by John F. Skinner, deputy city engineer of Rochester, N. Y.

The City Planning Division held its meeting jointly with the Town Planning Institute of Canada. James Ewing, vice-president of the Institute and consulting engineer, of Montreal, read a paper entitled "The Engineer and the Town Plan"; and G. H. Matthes, consulting engineer of the Fairchild Aerial Survey, Inc., New York, described the progress now being made in aerial mapping. Mr. Matthes suggested that a field for development in this type of surveying lay in city maps. The average city engineer's office, he said, had maps on large scales which were difficult to put together and inadequate for the purposes of the city as a whole. Mr. Ewing, in his paper, emphasized the growing magnitude of the traffic problem and the importance of engineering consideration of traffic in alleviation.

Concrete Proportioning—The best attended divisional meeting was the structural division, where a discussion on proportioning concrete took place. The first paper, by R. B. Young, the concrete expert of the Hydro-Electric Power Commission of Ontario, Toronto, was entitled "Producing a Concrete of Uniform Quality on the Job."

Mr. Young said the steps to obtain a quality concrete and to control the quality were: First, selection of materials; second, design of the mixture; third, handling of the materials; fourth, measuring of the materials; fifth, mixing; sixth, placing; and seventh, curing. The selection of materials is an economic problem. Good concrete can be made from a variety of materials, but the engineer must know how to select them so as to produce concrete at the cheapest price. In designing the mixture the engineer has to know what he wants and how to get it. We think of quality in terms of compressive strength, though that strength is not always a guarantee of durability or watertightness. The only practical basis of guaranteeing strength is by means of the control of the water. In handling the material care must be taken to prevent segregation. That is of major importance. In measuring the material the volume of cement can be measured either by bags or by weight. The water measurement can be obtained by any simple means, but the water in the aggregate is the crux of the situation. Some way must be devised for taking care of that. The aggregate itself is most difficult to measure, but the methods of measurement are matters of convenience and economy. He said there seems to be some misapprehension as to the effect of moisture in aggregate. Examinations of the great amount of work that the Ontario Hydro has done have shown that aggregate as obtained is more or less constant on the job; that normal changes do not introduce errors of any great amount. He has found an error of less than 3 per cent in volume of aggregate over an extended time. The important thing in the moisture content of the aggregate is not the effect on the volume

of the aggregate but on the gross amount of water contained in the mixture. One per cent variation in moisture causes a 3 per cent variation of water in the batch, which means in a 2,000-lb. concrete a change of 150 lb. In placing, the means of getting economy lies in transportation improvements, but the means of improving quality lies in such schemes and methods as will prevent segregation.

Mr. Young then outlined the process of proportioning concrete which has been so successful on the great amount of work that the Ontario Hydro has done. He has simplified his process very much since it was started in 1919. First, when a job is contemplated the engineer inspects all the available aggregate and picks out such aggregate as seems usable to be analyzed at the home office. It is analyzed by a simple method in which cylinder tests on varying proportions are made, the workability being determined by the eye of an experienced operator. The result aimed at is a decision as to the proper amount of water and the proper amount of aggregate with this given aggregate to produce a concrete of a desired strength.

From this analysis, tables showing the weight of the concrete, the weight of the cement, the amount of water, etc., are prepared, which constitute the basic data sent to the field superintending engineer on the job as a guide to the proportions of concrete to be used. This engineer then proceeds to make up a number of full size batches of the concrete to determine the workability of the designed mix. This designed mix is only the basis from which he may move backward or forward to an acceptable mixture on the job. In other words, field methods are the final deciding factor in the proportions. The difference between Mr. Young's method and some of the more complicated ones is that there is no reference to fineness modulus, surface area, void relations, etc., and no unnecessary complications in the analysis of aggregates, and that he uses the water-cement ratio of the specific aggregate as the basis of his proportioning and places no dependence on the average relationship is indicated by the well-known Abrams curve. He makes a curve of his own for the particular aggregate that he has to work with, and to get his exact water ratio, spots exactly on that curve the strength that he wants.

The scheme has proved very successful and is quite economical. He says that a skillful operator can develop with 25 cylinders a correct proportioning which can hold throughout a job with the same aggregate. These cost from $1 to $4 per cylinder, depending upon the type of laboratory, its availability, etc. He has on all jobs a field testing laboratory which costs less than $1,000. He thinks that possibly $200 a year would take care of the cost of such a laboratory which can make some of the most elementary tests that are necessary and useful to guarantee a proper mix.

In the discussion, F. R. McMillan, Structural Materials Research Laboratory, Chicago, called attention to the fact that the proportions reached by Mr. Young in his method give an over-sanded mixture; in other words, that the 1:2:4 of the old proportions is somewhat low in sand and that the relation of sand to stone is over one-half in the better proportioned mixtures.

Mr. McMillan read a paper by himself and Stanton Walker, of the Structural Materials Research Laboratory, entitled the "Water-Cement Ratio Specification for Concrete." The authors suggest the development and use of a specification for concrete based entirely on the water-cement ratio without restrictions on the amount of aggregate. They feel as a result of continued tests that the so-called Abrams curve showing a definite relation between water-cement ratio and strength is precise. It may vary for different aggregates, but for any given group of aggregates it holds. The authors commented on two other specifications for concrete. The first is the Joint Committee's present specification with its proposal of governing proportions by the slump, which the authors feel is not altogether reliable and which requires that the engineer must examine all available aggregates. The other one cited is the famous strength specification of Clause 28 of the 1921 report of the Joint Committee, which had the objection that one could not tell whether the specification was valid until after a 28-day test had been made; that tests are not altogether reliable; that the matter of arranging penalties if the tests were not met is difficult, and that the engineer passes the burden of his specification onto the contractor.

The authors, therefore, suggest a new specification which sets a definite water-cement ratio for each grade of concrete. It is proposed to select the maximum permissible water-cement ratio for the given concrete aggregates investigated. This ratio shall be selected so that it aims below the strength required in order that the worst batches will not be under the limit of strength desired. Any aggregate can be used that makes a workable concrete provided it passes the ordinary specification for cleanliness, etc. A special provision is made that the coarse aggregate shall not be less than the fine nor more than twice the fine. This insures an over-sanded mixture.

The recommended specification, according to its proponents, will insure uniform quality regardless of the aggregate and contractors will use the largest amount of aggregate consistent with workability. The authors took up the question of the difficulty of the contractor in estimating on a job on such a basis. They feel that it will be easy for him to make such an estimate if he knows the aggregate. If he does not know it, all he need to do is to make several very elementary examinations and tests of it to determine the proper proportions and from that make his estimate of quantities.

The authors reiterated Mr. Young's statement that the moisture content of the aggregate is not quite so serious a matter as has recently been thought. The maximum range of moisture on a certain job that they have under supervision at the present time is less than 3 per cent and the average daily variation is less than 1 per cent. A simple examination of the moisture content can readily be made and adjustment for it also made. On this particular job on which this specification is now being used the water-cement ratio is fixed so that the strength would theoretically be 500 lb. over the amount aimed at. In the tests they are getting an average of over 700 lb. over that figure.

A final paper on "Concrete Proportioning and Testing on the Exchequer Dam" was read for L. H. Tuthill, engineer on that dam, in California. The paper explained in detail an elaborate algebraic investigation of the volumetric and granular quality of a proposed aggregate, basing that analysis on the Abrams and the Talbot theories of proportioning. The method used seems to be the most complicated theoretical method that has been suggested for the newer methods of proportioning.

Machine Maintenance of Macadam, Monroe County, Mich.

Manpower Reduced by Dust Blower, Mechanical Chip Distributor, Tar Sprinkler and Locomotive Crane

BITUMINOUS surface treatment of macadam roads has become almost completely a machine operation in Monroe County, Mich. This county having a good limestone quarry has constructed almost all its county road system and some of the state trunk lines of water-bound macadam. Maintenance of these roads since 1917 has been by surface treating with refined tar, cold application. Some 250,000 to 300,000 gal. of tar are used annually and long experience has in late years enabled a very fine surface treatment to be developed. At the same time there has come a development of equipment for tar maintenance which has greatly reduced the manpower required. Views of this equipment at work are given here.

The first operation of cleaning the macadam surface is performed by a blower shown in Fig. 1. This was fashioned of an ensilage cutter and a motor truck, in the county shops. The knives of the cutter were removed and a tube attached which conducted a blast of air to the road surface. Under the truck was fixed a broom which loosens up the dust ahead of the blower. A few trips of the blower loosen the dust, blow it to the roadside and leave the surface in excellent condition for the tar. This is applied by a power distributor mounted on a truck. The pressure is secured by direct action of a pump which is operated by a power take-off from the truck motor.

It is in chip spreading, however, that the great saving in labor is made. At first, the placing of the cover material of stone and slag chips was accomplished in the usual way by stockpiling along the shoulders and spreading by hand. A view of such an operation, showing the large crew required so that the tar may be covered while still fresh and before it has begun to flow off the crown and haunches, is given by Fig. 2. For this crew the spreader truck shown by Fig. 4 has been substituted. From the tilted truck body the chips are spouted to a spinning disk and spread in an even layer.

With the spreading truck, the chips are put in 40- to 50-ton stockpiles placed at proper intervals and are loaded into the truck by a truck-mounted crane and clamshell outfit as shown by Fig. 3. The spreading truck follows closely the tar distributor and spreads first a thin cover—just enough to "hold" the tar. While the tar distributor returns for another load, the stone truck goes back over the first application and applies the balance of the cover material, a total of 15 to 18 lb. a square yard being used. Placing the cover in two layers is important. If it is attempted to spread the full thickness of chips in one operation, the truck falls so far behind the tar distributor that a large part of the tar is lost by runoff.

It will be noted that every machine unit is truck

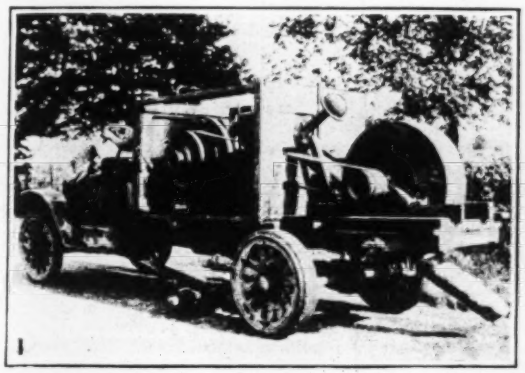


FIG. 1—BLOWER CLEANS MACADAM FOR TAR COAT
This machine was home made by mounting an ensilage cutter on a truck, taking out its cutter blades and using it as a blower.

FIG. 2—SHOVELERS SPREAD STONE CHIPS ON TAR COAT
In the old way a lot of men were required so that the chips might be got on before the tar had time to run off to the road sides.

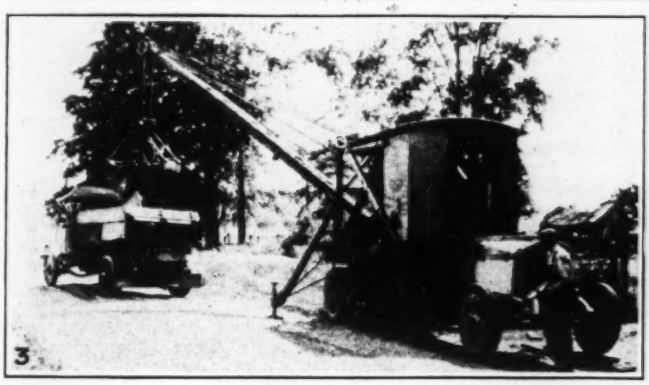


FIG. 3—STONE TRUCKS LOADED BY TRUCK CRANE
Even the loading crane is truck mounted and as mobile as are the blower, distributor and spreader units.

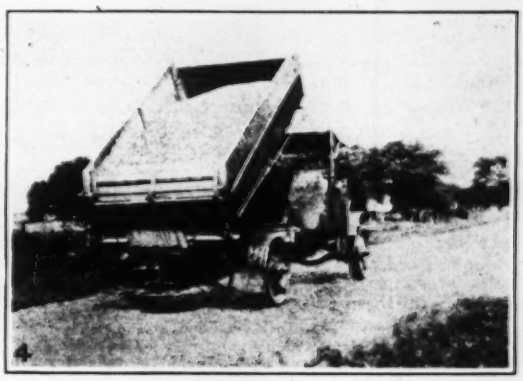


FIG. 4—TRUCK WITH WHIRLING DISK SPREADS CHIPS
One truck takes place of big gang of shovelers and covers all the road tarred by one distributor.

mounted and the entire outfit has all the mobility of a fleet of motor trucks. Its development, with the practices that have made it efficient, is the work of the Monroe County highway officials. In comment B. C. Tiney, maintenance engineer, Michigan State Highway Department, says: "We believe the mechanical means employed in conducting this work to be one of the most modern developments in reducing cost and eliminating manpower."

State Asks Designs and Estimates Free of Charge

Engineers Requested to Submit Competitive Designs for Bridge—"Successful Engineer" to Be Paid by Contractor

COMPETITIVE designs and estimates for a highway bridge have just been asked by the highway authorities of an Eastern state under circumstances which make the competition quite unusual in character. The highway department addressed a number of engineers in private practice, asking them to submit, free of charge, designs and estimates of cost for an important highway bridge. The request held out the definite promise that one of the engineers—the "successful engineer," method of selection not stated—should be paid *by the contractor* if the work were proceeded with.

The circumstances of the case are fully set forth in the attached correspondence, which is published for professional information and as a supplement to the cases discussed in our issue of Oct. 8, p. 578. Names and places are omitted, in order to divest the case of local aspect.

Highway Department Invites Designs

Sept. 28, 1925

Dear Sir:

This department contemplates the construction of a bridge across the ..... River at ..... St. in ....., some time in the next year. There are sent you separately three prints showing data necessary for the preliminary design and estimate of a suitable structure for that site.

It is regretted that no appropriation can be made from highway funds for payment on any preliminary sketches or estimates submitted, but it is planned to pay the designing engineer, through the contractor who is awarded the construction as a part of the cost of the structure. We will await your design, estimate and engineering cost with a great deal of interest.

If you are not interested in the above proposition please return the prints.

Very truly yours,
STATE HIGHWAY DEPARTMENT.

* * *

Engineer Asks For Information

Sept. 30, 1925

Dear Sir:

We cordially appreciate the courtesy of your letter of Sept. 28, addressed to the writer, extending an invitation to prepare the design and estimate for the proposed new bridge across the ..... River at ..... St. in .....

We should be very glad to furnish the required professional services. With our past experience in the estimating, design and construction of movable bridges, we can assist you in securing the most economic and efficient design of movable span for this crossing.

Before commencing on this work, we should like to have further information along the following lines:

1. Is this a competition to which more than one designing engineer is invited, or may we regard your proposition as an individual offer of the professional engagement to prepare the design and estimate?

2. Upon our acceptance of your offer, can you give us official assurance that the bridge will be built and that we shall be compensated for our services in preparing the design and estimate as well as for any additional services you may authorize?

3. Would our professional compensation be officially stipulated as a definite amount to be paid by the bidder who is awarded the construction of the bridge, or would we be required to negotiate with the successful contractor for our compensation?

We shall look forward to your prompt response to these questions, and to the pleasure of being associated with you on this work.

Faithfully yours,
CONSULTING ENGINEER.

* * *

Details of Proposed Procedure

Oct. 5, 1925

Dear Sir:

Your letter of Sept. 30 in reference to the ..... St. bridge at ..... has been received. We will take up the questions asked in it, in order.

1. The plans and letter as received by you, have been sent to several consulting engineers.

2. We feel that the bridge will be built as there is urgent need for it, but no compensation could be provided for any engineers submitting designs, if the bridge is not built.

3. Our method of payment would be to include the engineering expenses for the design and estimate in the amount of the bid submitted by the contractor for the bridge. The contractor would then pay the successful designing engineer the amount stipulated in the special provisions of the contract. We would give definite assurance that the amount would be paid.

This I believe covers all of the points in your letter.

Very truly yours,
STATE HIGHWAY DEPARTMENT.

* * *

Engineer Declines Invitation

Oct. 6, 1925

Dear Sir:

Please accept our thanks for your letter of Oct. 5 submitting the additional information we requested concerning your invitation for professional services on your ..... St. bridge at .....

As much as we should like to be associated with you on that work, we regret that we have to decline the proposition on the terms outlined by you.

It is contrary to our principles of professional conduct to engage in a competition in which different engineers are asked to name their prospective charges. Experience has shown that such competition seldom results in the engagement of the best engineer for the work and that moreover the compensation fixed in such manner is seldom compatible with the rendering of proper engineering services.

It is also contrary to our principles to engage in a competition in which arrangements are not made to pay the invited competitors for their labor and expenses in preparing designs.

It is further contrary to our principles to submit preliminary estimates for any project in competition with other engineers, since such competition gives the advantage to the engineer with the most elastic conscience, and since, moreover, gratuitous estimates are not compatible with a conscientous and thorough analysis of the engineering problem.

If you can modify your terms so as to eliminate the conditions above indicated as objectionable, we shall be very glad to make arrangements with you for furnishing the required professional services.

Sincerely yours,
CONSULTING ENGINEER.

Timber for Quebec Harbor Moved by Canal

The Northern Construction Co. of Vancouver, B. C., which recently secured the contract for the Quebec harbor improvement work, expect to move 20,000,000 ft.b.m. of timber from the Pacific Coast to Quebec. This movement will extend over a period of two years and will be made by way of the Panama Canal.

From Job and Office

Hints That Cut Cost and Time For the Contractor and the Engineer

Concrete Pavement on Timber Floor of Bridge Approach Trestle

DUE TO an uncertainty as to the best arrangement for the future local and through traffic when the recently completed Spokane St. bridge in Seattle was designed, it was decided to use temporary construction for the east approach. The very heavy traffic across this bridge would wear down a plank floor so quickly that very frequent repairs would have been necessary; a roadway paved with wooden blocks would have been too slippery on the steep grade of the approach, and it was therefore concluded that a concrete surface roadway would give the best service.

The concrete pavement would make repair of the supporting timbered floor difficult and costly. It was therefore decided to make this part of the structure of creosoted lumber. On the other hand, in view of the ease with which bents could be renewed, it was decided to use untreated timber in the bents. Concrete piles were used for foundations.

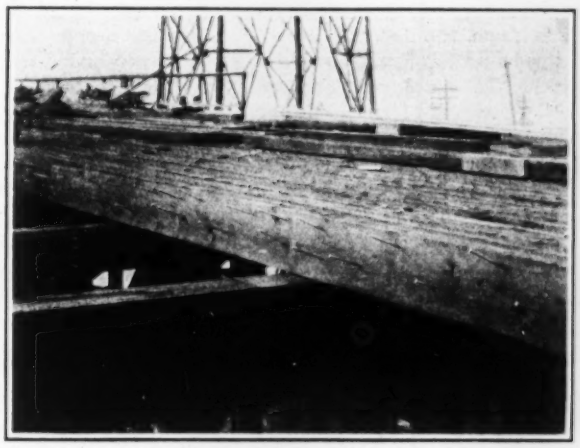
The timber floor carrying the concrete slab of the roadway was constructed as a continuous laminated floor, 8-in. in depth, using 4x8-in. planks on edge, fastened together with 8-in. wire nails every 12 in. In order to get a better distribution of wheel-loads on the floor than could be obtained by this nailing alone, an 8x8-in. timber was run transversly under the floor timbers at the center of each span, and the 4x8-in.

UNDER SIDE OF FLOOR SHOWING BEAM BETWEEN BENTS

planks were each fastened to this transverse timber by galvanized steel clips and two $\frac{3}{8}$x3½-in. track nails. These clips were twisted through a right angle at the center so that two spikes through holes in the upper part could be driven into the floor timber while two through the lower portion could be driven into the cap. This detail is shown in the accompanying illustration, alternate timbers being spiked to opposite sides of the cap. The laminated floor is fastened to the caps with $\frac{5}{8}$-in. drift bolts 22 in. on centers.

The concrete wearing surface is 5 in. thick, reinforced with two layers of wire netting. Expansion joints were placed over each cap and along the center of the roadway. To prevent any movement of these concrete slabs under the tractive effort employed on the steep grade of the approach, a bond was provided by $\frac{3}{8}$x5-in. boat spikes which were driven into the creosoted subfloor and left to project 2 in. into the concrete.

When this article was written the concrete and timber combination floor had been in use for about ten months under very heavy traffic and was reported to have shown no indication of cracks in the concrete slabs nor undue wear in any part, and in general to have been very satisfactory.



PLACING LONGITUDINAL TIMBERS IN FLOOR SYSTEM

The design and construction were under the general direction of A. W. Munster, acting bridge engineer, city of Seattle.

Well Flow Measured by Pitometer Checked by Orifice

By John N. Brooks
Hydraulic Engineer, Department of Conservation and Development, Trenton, N. J.

THE writer recently measured the yield of a well discharging approximately 1,000 gal. per minute by means of the pitometer, obtaining simultaneous readings of head on an orifice provided by the company which furnished the well pump. The results obtained by the two methods agreed within 1.2 per cent and are set forth in the following table as evidence that, under favorable conditions, either the pitometer or an easily-constructed orifice may be used to measure the yield of wells sufficiently accurately for most purposes.

No of Readings at 10-Min. Intervals	Speed of Pump, r.p.m.	Discharge, Gal. per Min. — Pitometer	Discharge, Gal. per Min. — Orifice	Discrepancy, Per Cent
7	1,180	994	1,006	1.2
7	1,137	928	927	0.1

The pitometer used was a standard simplex round rod meter, not specially calibrated and the formula used in computing velocity was that given by the manufacturer, namely $v = 1.667\sqrt{s - 1}\sqrt{d}$; wherein v = velocity in feet per second, s = specific gravity of the fluid used in the manometer, d = deflection of the manometer fluid in inches.

The velocities observed during the traverse of the pipe ranged from 4.489 to 7.403 ft. per sec., with a nearly constant center velocity of 6.68 ft. per sec.; represented by manometer deflections of from 12.50 to 34 in., using a fluid of 1.585 specific gravity.

The rod meter was placed vertically in the center of a straight horizontal run of new 8-in. cast-iron pipe 166 ft. in length.

The orifice used was made up as follows: A piece of 8-in. standard weight black steel pipe 38 in. long had a standard screwed pipe cap threaded on one end. The pipe cap had been placed in the lathe and a 6-in. diameter orifice cut in its center, producing a square-edged orifice having walls $\frac{3}{4}$ in. thick. Thirteen inches back from the face of the cap a $\frac{1}{2}$x4-in. nipple was tapped into the 8-in. pipe but did not extend inside the pipe. This nipple was connected to a glass piezometer tube by means of rubber tubing. The 8-in. orifice pipe was calked into the end of the cast-iron discharge pipe and supported horizontally 4 ft. above the water surface in a receiving basin.

This orifice had been calibrated by the maker and the formula was stated to be $Q = 0.684 A\sqrt{2gh}$, wherein Q = discharge in gallons per minute, A = area of orifice in square inches, $2g = 64.4$ and h = head above the center of the orifice in inches of water. Transforming into the more commonly used units, Q in cubic feet per second, A in square feet and h in feet, the value of K becomes 0.760.

The deflections of the manometer fluid and the height of the water column in the piezometer were measured with an ordinary 6-ft. folding rule, reading to $\frac{1}{8}$ in.

Mast and Spout Concreting Plant Has Special Features

SPECIAL equipment, unusual methods and rapid pouring of concrete are features of the concreting plant for the memorial hospital and medical hall at the University of Chicago. Three steel masts with long spouting systems which require no high-line supporting cables serve the entire area. The hospital is 299x363 ft. and the medical hall 266x45 ft. Both buildings will be six stories high, with floors of the beam and joist type

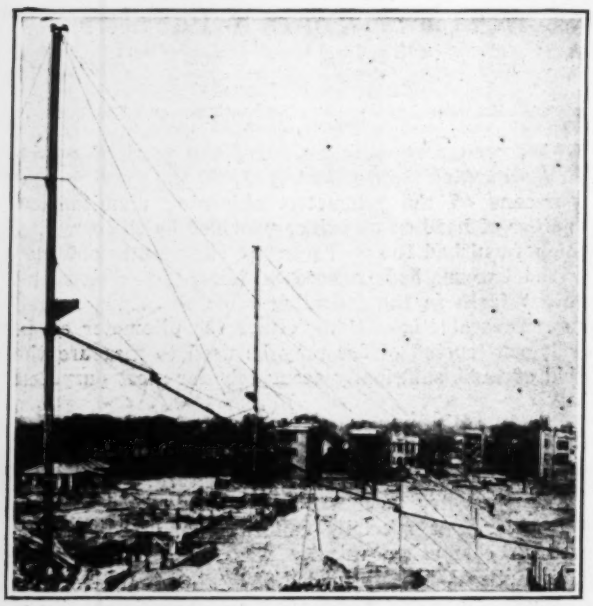


FIG. 1—LONG SPOUTS WITHOUT HIGH-LINE CABLE
This spout extended more than 300 ft. from the mast.

From Job and Office

Hints that Cut Cost and Time

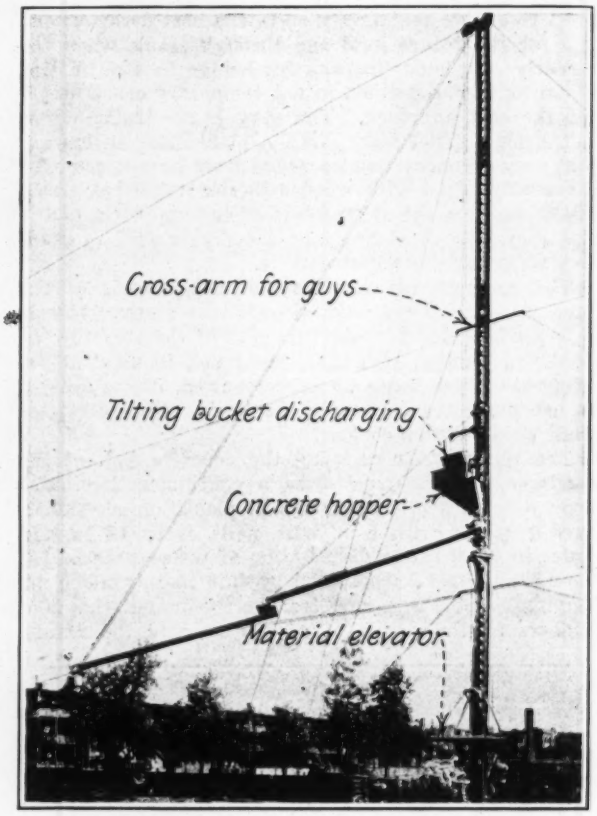


FIG. 2—CONCRETING MAST CARRIES BUCKET AND PLATFORM ELEVATOR

(having steel pan forms) and will require together about 25,000 cu.yd. of concrete.

Two masts 160 ft. high serve the larger building and one 120-ft. mast serves the smaller one. They are built up in 20-ft. lengths and are guyed by cables attached to the top and crossarms at intermediate points, these arms carrying the guys clear of the bucket and the platform elevator. Four small channels forming the corners of the mast are connected by latticing and serve as guides for the bucket frame. A tilting bucket with a capacity of 18 cu.ft. is used, handling a 3-sack batch; this discharges automatically into a 1-yd. hopper which can be placed at any desired height on the mast. The mixer operator controls the hopper gate, admitting concrete to the chute. Complete discharge and freedom from clogging and leakage are claimed as advantages for the tilting type of bucket. Gasoline hoists with silent-chain drive are used and give a hoisting speed of about 180 ft. per minute.

Rapid work is reported, with 200 cu.yd. of concrete poured from each tower in an 8-hour day. The aver-

From Job and Office

For Contractor and Engineer

age rate is given as 140 cu.yd., with the aid of five men wheeling aggregate, one man handling cement and one man operating the hoist, or seven men in all. This means the placing of 420 cu.yd. daily with 21 men.

Another feature is the spouting of concrete directly to the pan forms of the slab and joist floors, thus avoiding the expense of distribution to the forms by men with buggies. It has been thought that such practice with the relatively narrow forms for the joists would result in numerous surface voids, necessitating much finishing by hand. To overcome this objection, a bucket load of grout is sent down the chutes before commencing to pour the concrete, while the coarse aggregate is smaller than usual, the size of stone not exceeding ½ in. It is found that the grout will spread and the concrete will push it along the forms and fill all corners, so that when the forms are removed there is a smooth and even surface. It is expected that in this way all the concrete can be spouted directly to the forms. In the columns, the concrete is stirred or agitated with long sticks of wood to insure density and prevent voids. Furthermore, the concrete is spouted successfully to a distance of more than 300 ft., which is considered an exceptional distance for spouting without the use of a high-line cable or counterweights.

For the spouting, the first 30-ft. section is attached to the mast and has its outer end suspended by a cable. To this end the second section is attached and in turn is supported by tackle led from the top of the mast. A winch on the outer end of this second section has a cable which holds up the adjacent end of the third section, while from this point to the discharge end the spouting is either slung from guyed poles or is attached to gin poles used for various purposes on the work. When the line of spouting is to be shifted, the end of the third section is lowered by the winch.

Where the material elevator is used, its guides are on one side of the mast, adjacent to that on which the bucket carriage is mounted. A bracket with the hoisting sheave is placed below the concrete hopper, as shown in the view, since it is rarely necessary to hoist material higher than this hopper. Plans are being made, however, for a larger platform elevator having its hoisting cable led over an arm at the top of the mast, so that the elevator can be run to the full height.

The erection of these tall masts is a "stunt" in itself. A 30-ft. gin pole on the ground sets the first 20-ft. section of the mast on the anchor bolts, which are embedded in a block of concrete capped with a base plate. A bracket is then bolted near the top of the mast section and the gin pole is seated on this to raise the second section, the sling being attached in such a way that the second section is nearly vertical and can be seated readily in place. With the bracket shifted to the second section the operation is repeated. The top section of the mast carries the sheaves for the bucket cable. Guy lines attached to the four corners are led to deadmen or to adjacent buildings, but in one case where guys were not practicable the mast was placed close to an adjacent building and was secured to it by horizontal braces.

For the University of Chicago buildings, the architects and structural engineers are Coolidge & Hodgdon; the William Adams Co. has the general contract. Information as to the concreting has been given by the Archer Iron Works, Chicago, which firm furnished the towers and chuting equipment.

Spoil-Bank Spreader on Canal Work

IN THE real-estate development for a summer resort known as Lake Delavan Highlands, near Delavan, Wis., a canal was built connecting with Delavan Lake, so that residents could dock their boats in a small artificial lake on the property. It was necessary to level the 14-ft. spoil bank, spreading the material over

FIG. 1—LAND-LEVELER SPREADING SPOIL BANK

a distance of about 250 ft. on soft and boggy ground, and for this purpose a 3-yd. agricultural land-leveling machine was used. The machine was handled by a tractor and operated by compressed-air under control from the tractor. With this equipment, shown in Fig. 1, the contractor moved about 250 cu.yd. daily.

This land leveling machine resembles a large tractor-hauled fresno scraper, but with a compressed-air device for dumping, while the scoop in its dumped position levels the surface. From a compressor on the tractor the air is piped to the leveler, the operation of which can be controlled through a four-way valve either by the driver of the tractor or by a man riding on the leveler. The machine, which is used for railway, road and other grading work as well as for land leveling, is made with scoops 8, 10 and 12 ft. long, having a capacity of about 2, 3½ and 5 cu.yd., respectively.

For excavating the canal, a light dragline machine

FIG. 2—DRAGLINE EXCAVATING BOAT CANAL

was used, having a 40-ft. boom and ¾-yd. bucket, as shown in Fig. 2. This canal is 2,200 ft. long, 10 ft. deep and 35 ft. wide on the bottom, with slopes of 1 on 1½, giving a yardage of about 36,200 cu.yd. The boat lake is 150 ft. in diameter, 14 ft. deep and with the same side slopes, requiring about 5,654 cu.yd. The bottom of the canal and lake are in gravel, with numerous springs, while the marshy ground will be drained by the canal. It is intended to smooth the side slopes of the canal and lake and then sow them with grass seed.

John T. Degen was the engineer and Ferd Robers was the contractor, both of Burlington, Wis. Information as to this interesting piece of work has been furnished by the Hunter Machinery Co., Milwaukee, Wis., which supplied the excavating and land-leveling plant.

Trough for Dipping Cable Guard Rail

By Rorert A. Palmer
Project Engineer, Michigan State Highway Dept., Prudenville, Mich.

THE specifications of the Michigan State Highway Department on cable guard rail call for the cable to be painted with one coat of red lead and two coats of white paint. John Nash, subcontractor for Orr & LaPorte on trunk line 18-18 A² in Gladwin County, after painting all the cable on one contract by hand (three coats) decided that dipping would be quicker and more satisfactory. As a result he devised the trough herewith pictured. It is 16 ft. long and has a depth of about 4 in. for the central 10 ft. of its length. The width is 4 in. and the material may be wood or metal.

Both cables were dipped, thoroughly drained and then brushed off to remove any surplus paint. About

DIPPING TROUGH FOR HIGHWAY GUARD RAIL

10 ft. of cable can be painted before moving the trough. When the entire length has been painted the cable should again be brushed off to remove any further drops of paint that might dry and cause blisters.

From Job and Office

Hints that Cut Cost and Time

The red lead used was about twice as much as would be used had it been brushed on, but the cost of additional paint was offset by the fact that two men did the entire job of painting instead of six. These two men painted as high as 2,500 lin.ft. in a 10-hr. day. Only the coat of red lead and the first coat of white were dipped, the final coat of white being brushed on. The dipping method has proven very satisfactory and has the approval of G. C. Dillman, deputy commissioner and chief engineer of the Michigan Highway Department.

Rapid Reconnoissance and Mapping Secured by Pacing

By Frank A. Glass
Mining and Civil Engineer, Brainerd, Minn.

A METHOD used by many geologists for running compass traverses by pacing is applicable to so many kinds of reconnoissance surveys that it may be of value to some engineers.

"Standard courses" are described as those whose tangents or cotangents are ¼, ½, ¾, or 1. They make angles with the meridian of 14 deg., 26½ deg., 37 deg. and 45 deg., and their complementary courses are 53 deg., 63½ deg. and 76 deg. Their corresponding distances are 1.03, 1.12, 1.25, and 1.41, while the complementary courses have distances which are recorded in reverse order, or 1.25, 1.12, and 1.03. One co-ordinate is always unity, and the other is ¼, or multiples of ¼ up to unity. These co-ordinates can be platted in a properly ruled field note book more quickly than courses and distances can be written. The note book automatically becomes an up-to-the-minute finished traverse map, upon which detail can be placed as rapidly as taken, showing at once the relation to other details recorded.

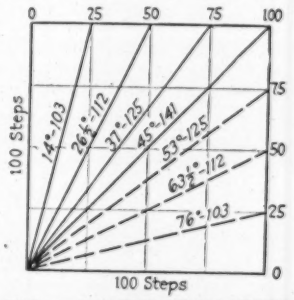


FIG. 1—VALUES OF 100 STEPS ALONG STANDARD COURSES

For all practical purposes of reconnoissance, "standard courses and distances" fit the easiest lines of travel, as a winding road, stream, ravine, or ridge, where a "tally" is taken as 100 nominal steps, or its diagonal equivalent. Rarely is it necessary to use a fractional tally or to interpolate between "standard courses."

It is not necessary, or even desirable, that a person actually walk along such standard courses, as speedier and more accurate results are attained by adjusting the tally for natural topographic obstructions. Merely counting steps as one walks along is not considered proper traversing.

In Figs. 1 and 2, two thousand nominal steps are taken as a mile, and 100 nominal steps as a tally. The actual number of steps is a matter for each individual to determine under conditions he meets, which vary continually. Although the standard courses and distances are easily remembered, they may be noted

From Job and Office

For Contractor and Engineer

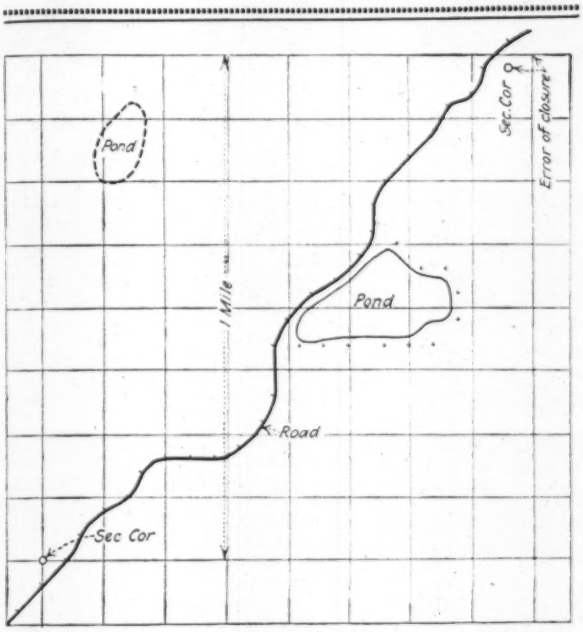


FIG. 2—TRAVERSE PLOTTED BY STEP METHOD

inside the compass case, or even etched on the glass cover of the compass.

Before starting on an extended expedition the novice may perhaps gain confidence by practising with a tally of 20 steps and platting on a large scale. Once having acquired skill in using such methods he will never revert to methods requiring map work at the end of a hard day in the field.

Where much detail off the line of the traverse must be mapped the engineer may have an assistant who runs and plats the traverse, and is halted as required and asked for the co-ordinates of his position.

The conspicuous dots (Fig. 2) marking the ends of each tally, are a great aid in properly interpreting a reconnoissance map. For instance we may take as substantially correct the location and size of the pond closely encircled by a sub-traverse, but we should be obliged to question the location and size of the pond observed from a distance of a half mile, even were it not shown by a dotted line.

Where secrecy of the mission is required, a skilled man may quickly and without arousing curiosity regarding his purpose, obtain all data requisite to obtain options, before detail men appear on the scene.

Story Added to Soap Warehouse by Raising Roof

WITH very little interruption to the actual storage of materials a single-story warehouse 100x500 ft. in plan, belonging to Procter & Gamble, soap manufacturers, Port Ivory, Staten Island, was made into a two-story warehouse. Doubling in the warehouse space was effected by raising the monitor roof and putting in new steel to support the second floor.

The warehouse is a brick structure, the roof system being carried on trusses supported at one end by a line of columns running down the center of the warehouse and on the masonry wall at the other end. The spacing was about 20 ft. and the span 50. With the building raised a story, new columns were put in 17 ft. either side of the center line of columns and at the wall to support the new steel for the second floor which was designed to carry a load of 400 lb. per square foot.

Column footings were put in first. Then the existing steel was underpinned by cribs of short 12x12s. These timber cribs were built flush against the sidewalls and in the center under alternate trusses. The load was then transferred from the columns and masonry bearing wall by pump jacks. With the load transferred the masonry at the end trusses was picked away so that the trusses were free to be raised. The masonry in the entire wall was then torn down to the underside of the existing trusses. The steel sash remained and was raised with the trusses. With the nine bays raised to full height of the raised structure, the new steel was erected and masonry was carried up to the bottom of the trusses, the latter remaining wall bearing. The center columns of the old steel were incased in reinforced concrete and underpinned by heavy reinforced-concrete columns supported on reinforced footings.

Particular difficulties, of course, were encountered in this reconstruction work because the storage of soap which came from the factory on two belt conveyors was never interfered with.

The work was in direct charge of C. W. Knipp, construction superintendent with H. K. Ferguson Co., Cleveland. Though the contract called for completion of the job in five months, the building will be turned over to the owners in four months' time.

Job and Office Notes

A Cultipacker, Drawn by a Tractor, is being used by the town of Bowman, N. D., in street work. Scoria is used extensively as road surfacing material. When the scoria is taken from the pit it comes out in chunks and has to be crushed before it makes a surface of easy riding qualities. The scoria is spread on the road and the cultipacker is drawn over it. The packer crushes the larger pieces and smoothes out the roadbed. Prior to running the packer over the scoria, a certain amount of dirt is graded into it and

the combination makes a road of excellent wearing quality. Tests are now being carried out by the town officials and indications point to the fact that this surfacing material compares well with gravel for durability.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

General Contractors Oppose Day Labor

Bill To Limit Federal Day Labor To Be Urged Upon Congress—Bonding Discussed

An effort to secure introduction and passage of a bill designed to limit the amount of work which may be undertaken by any Federal government agency by day labor will be made by the Associated General Contractors of America when Congress meets in December. This decision was one of the outstanding results of the semi-annual meeting of the directors and advisory board of the organization, held at Dallas, Tex., Oct. 5, 6 and 7. It is hoped to get national legislation and then to work for similar legislation effecting states, counties and municipalities, as well as other political subdivisions.

The bonding question was discussed at length and several resolutions aimed at indiscriminate bonding were adopted. Seasonal operations also were discussed, the consensus of opinion being that the campaign of education to lengthen the construction season is bearing fruit. In the last three years, the average time spent on highway construction has increased from 101 to 168 days a year.

The meeting approved the questionnaire to determine the competency of a bidder which was suggested by the Joint Conference on Construction Practices. The financial statement for bidders, and a statement on credit, also were adopted. Among the resolutions on bonding was one urging contractors to adopt specific practices as follows:

First, that at every general meeting of a branch or chapter time be assigned on the program for a full and free discussion of the contract bonding situation, and for the collection at such meeting and forwarding to Washington headquarters of as much detail information on the subject as may be brought out in such discussion.

Second, that local secretaries be instructed and required to report to Washington headquarters monthly the names of all surety companies on defaulted contracts within their jurisdiction.

Third, that an unremitting campaign of publicity be pursued in the association publications and the newspapers of the country to educate the public mind to the necessity for establishment of discriminating standards in the underwriting of contract bonds.

Fourth, that as a silent protest against existing conditions in our industry a sticker be prepared and furnished to the membership for use on all proposals made by members of this organization, to read as follows: "We do not consider a corporate surety bond of adequate value or protection to owners until underwriters have provided disinterested bureaus to facilitate sound investigation of the skill, integrity and responsibility of bidders."

Engineering Fifty Years Ago

From *Engineering News*, October, 1875

WATER Supply Works.—The first water works in the United States were planned and constructed by Mr. John Christopher Christensen, at Bethlehem, Pa., in 1762. The machinery consisted of three single-acting force pumps, of four inch calibre and eighteen inch stroke, and worked by a triple crank, and geared to the shaft of an undershot water wheel, eighteen feet in diameter, and two feet clear in the buckets. The water was raised by this machinery to the height of 70 feet, and subsequently to 114 feet. The works were in operation as late as 1832. The first rising main was made of gum-wood, as far as it was subject to great pressure, and the rest was of pitch-pine. In 1789 leaden pipes were substituted, and in 1813 they were changed for iron.

Black Butte Cut-Off Construction Authorized by Commisssion

Construction of the Black Butte cut-off by the Central Pacific Railway Co., a subsidiary of the Southern Pacific Co., has been authorized by the Interstate Commerce Commission. The new line will start from a point on the Shasta division at a point about 4 miles south of Weed Station and extend northeasterly to a point on the Klamath Falls branch near Grass Lake, a distance of 23.7 miles all in Siskiyou County, Calif. The cut-off is in the northern portion of California and is intended to become a part of the railroad company's line via Klamath Falls and the Natron cut-off. It will cut off a portion of the Klamath Falls branch which has very heavy grades and much sharp curvature.

The estimated cost of construction is placed at $3,655,000. Work is to commence at once and be completed within fifteen months.

Income Tax Argument Set for November 30

The argument before the United States Supreme Court, on appeal, in the federal income tax cases of Metcalf & Eddy and of the employees of the Municipal Street Railway Department of Detroit, Mich., has been scheduled for Nov. 30.

State Utility Commissions Seek Federal Power

Prepare Bill to Place Federal Powers Over Motor Bus Lines in Hands of State Commissions

Washington Correspondence

That the utilities commissioners of the various states see great possibilities of increasing the scope of their authority through the plan for Congress to make the state commissions a sort of federal agency, became very clear during the course of the thirty-seventh annual convention of the National Association of Railroad and Utilities Commissioners in Washington last week.

The idea of federal and state co-operation in regulation of utilities came up for discussion in connection with the proposed motor bus bill. That bill provides that Congress shall confer its federal powers and jurisdiction upon the individual state commissions, making each commission, within its state, a federal agency and thereby making it possible for the state commissions to exercise federal powers, as well as that conferred by the state. Applied to bus and truck common carriers it seemed to be the consensus of opinion that adjoining states could regulate rates and fares without great difficulty. The plan seems entirely satisfactory to those who believe in the principle of local responsibility and to those who are opposed to further bureaucratic control from the central government. Most of the commissioners were outspoken in their belief that the bus and the truck will be disturbing factors in the transportation situation unless they can be brought into line with other regulated forms of common carrier.

Intrastate Regulation

It was very apparent that the commissioners see the possibility of applying this idea to interstate electric service. If made a federal agent by Congress the state commission, many think should have no trouble in doing what Secretary Hoover recommended—controlling interstate traffic in electricity by fixing prices at which the product could be sold. Without such a grant from Congress doubt was expressed whether such an act by a state commission would not be held by the court as interference with interstate commerce. Such a grant of federal power to each state, it was emphasized, would require the right of appeal to the Interstate Commerce Commission when the states concerned could not agree. It was predicted that with the right of such an appeal the states rarely would fail to handle the situation and the number of appeals to the Interstate Commerce Commission will be few. Many of the commissioners seem to think that this plan offers the best means of co-ordinat-

ing state and federal powers and reconciling the principle of federal organization with local responsibility.

Despite the fact that the situation precipitated by the growth of motor transportation was the matter in which the majority had a very keen interest, fully 75 per cent of the time was devoted to the problems of steam transportation. The readjustment of freight rates has brought great popular pressure on the commissions to secure their revision downward. In the case of the electric utilities there has not been the same dissatisfaction over rates and as a result the commissions have heard less from the public in that connection.

REGULATION OF ELECTRIC UTILITIES

There was very general agreement that the business of the electric utilities is so largely intrastate that it is a state rather than a federal problem.

Secretary Hoover, in his discussion of regulation of large electric utilities said:

"It is difficult to conceive of a situation which, so far as public interest goes, could not be controlled in this simple and effective manner. It needs no new machinery, no complicated interstate compacts between each of 48 States and its numerous neighbors, each requiring sanction by Congress.

"There is an economic question involved in this matter of the development of power 'districts' which I believe needs the attention of the state commissions, and action upon which would cure the evil if such should develop. There is a limit to the size to which operating districts should be extended. The economies of central generation, of best diversity of load, have a territorial limitation in each case, beyond which no advantage is gained. Moreover the attention to service and response to local responsibility decreases after some maximum area has been reached. The best use of surplus power from one district to another can be reached by purchase and sale through interconnection of districts. Moreover it is important to preserve a large number of districts in order to stimulate invention and improvement and, upon failure of a district operating company, to thus keep open the door of competition as the final remedy. Therefore, it seems to me highly desirable that the state commissions should study this problem in its broad aspects and through their undoubtedly existing powers scrutinize and disallow consolidations unless economic value to the commodity can be demonstrated."

GRADE CROSSINGS

The committee on grade crossings, in its report, stated that it had "devoted two full days to the consideration of a tentative draft of a uniform vehicle act, prepared and submitted by the National Conference of Commissioners on Uniform State Laws. The tentative draft was a voluminous document covering every phase of the subject. Obviously it will be difficult to finally adopt a measure which will be acceptable to every state. The conflicting views expressed by members of the committee clearly show the diversity of opinion existing. However, it is a move in the right direction and this association should lend its support to the movement.

"Minnesota and North Dakota Legislatures enacted so-called 'grade crossing laws' during the 1925 sessions which are practically identical. By the terms of these laws the railroad commissions are required to classify all the crossings according to their hazardous condition; require uniform crossing signs and signals, and by other methods make the crossings safe. The commissions are given enlarged powers with respect to requiring the separation of grades and are authorized to designate crossings where all vehicles are required to come to a full stop. The act makes it a misdemeanor for failure to stop before approaching crossings designated as full stop crossings. The commissioners of the two states have adopted practically the same rules and regulations and are otherwise co-operating to the end that there may be uniformity. We mention this in the hope that other state commissions will take similar action." A copy of the Minnesota law was printed in the report of the committee on the safety of railway operation with comment on the way it is being put into effect.

Report on Proposed San Gabriel Flood-Control Dam

The Los Angeles Board of Supervisors on Sept. 17 received a report on the proposed flood-control dam in San Gabriel River, prepared jointly by D. C. Henny, Portland, and J. D. Galloway, San Francisco. The dam is estimated to cost $25,000,000 and is the largest item on the $32,000,000 flood control program for which bonds were issued last year, and which was described in *Engineering News-Record*, June 26, 1924, p. 1088.

The report is confined to the design of a dam for a given location and does not take sides in the controversy over locations. In general it approves the plans prepared under the direction of J. W. Reagan, chief engineer, Los Angeles County Flood Control District, and suggests only minor changes.

Meter Progress in Chicago

In a report on metering to Col. A. A. Sprague, commissioner of public works of Chicago, John Ericson, city engineer, recommends metering first the belts of high consumption. He bases his argument on the fact that an emergency exists or is imminent next summer. Where only three pumps out of four were necessary in 1924, in one of the largest stations, all four were required in 1925. The area or belt bounded by Fullerton Ave. on the north and Twelfth St. on the south has a consumption of nearly double that of the average and Mr. Ericson believes that is the place to start.

Owing to the time it will require to develop a satisfactory "city" type of meter he recommends advertising for meters in the regulation way for the time being.

Capt. Earle Inaugurated as Head of Worcester Polytechnic

Capt. Ralph Earle, U. S. N., retired, is to be inaugurated as president of Worcester Polytechnic Institute today to succeed Dr. Ira N. Hollis.

Capt. Earle has had a distinguished career of more than 30 years in the United States Navy. He was chief of the Bureau of Ordnance, with the rank of rear admiral, during the period of America's participation in the World War. Subsequently he commanded the U. S. S. "Connecticut" for a short time, then was made chief of staff of control force, and in May, 1922, took command of the Naval Torpedo Station at Newport, R. I. Last spring he received leave of absence in order to assume the presidency of Worcester Polytechnic Institute. His official retirement from active naval service occurred on Aug. 25. During his naval service, Capt. Earle has had considerable academic experience having been assigned to duty at the Naval Academy as head of the department of ordnance and gunnery and of the department of English, and at other times for service in various departments.

Detroit Voters Approve Street Widening Project

The electors of Detroit, Mich., voted on Oct. 6 in favor of three street widening projects which are estimated to cost more than $100,000,000. The three streets designated for the improvement are Woodward, Gratiot and Michigan avenues.

The project of the City Plan Commission for the widening of Woodward Avenue on the east side of the thoroughfare from Grand Circus Park to the limits of the city of Highland Park was approved. The cost of this project has been variously estimated at from $50,000,000 to $100,000,000. The width will be 120 ft. for a distance of approximately four miles.

The second plan calls for the widening of Gratiot Ave. from Randolph St. to Pennsylvania Ave., a distance of approximately four and one-half miles, to 120 ft. in width, and the third project approved includes the widening of Michigan to the same width as the other two streets for a distance of approximately three miles between Fifth St. and Livernois Ave.

The plan for widening Gratiot Ave. was also sponsored by the City Plan Commission as a means of relieving intense traffic congestion on this artery to the northeast. Woodward Ave. gives an outlet to the north while Michigan Ave. is a main east and west thoroughfare starting at the heart of the city. In the case of Woodward Ave., a counter plan to the one adopted by the voters had been designed to save slicing the fronts off five churches on the east side of the street.

California Water Works Men Meet at Santa Cruz

Symposiums Are Chief Features of the Convention—Pipe Jointing Actively Discussed

At the sixth annual convention of the California section, American Water Works Association, held at Santa Cruz, Oct. 15 to 17, with 240 members and guests in attendance, there was a very general participation in discussions at all sessions. The several symposiums were particularly well received because of the opportunity they afforded for the direct exchange of ideas on ways and means of meeting the problems of water works operation.

Officers elected for the ensuing year were as follows: Chairman, C. B. Jackson, Fresno; Vice-chairman, S. B. Morris, Pasadena; secretary-treasurer, Paul Magerstadt, Oakland. San Diego is the city selected for the next annual convention.

An attractive feature of the convention was the manufacturers' displays, arranged on three sides of the convention hall.

Jointing Cast-Iron Mains

In the symposium on methods of jointing cast-iron water mains, discussion centered on lead, leadite and cement joints. In making cement joints the most important element is the use of the right amount of water with the cement. Only enough water should be used to make the cement stick together in the palm of the hand without squeezing and the mixture must be tamped very tightly into place. Ample water for setting may be expected to be absorbed from the surrounding earth. Packing is believed unnecessary in a few cities but most systems use oakum or jute especially where the line is not perfectly straight. Oakum containing tar or oil is unsatisfactory.

The sweating in cement joints just after laying is only temporary and may be depended upon to "take up." After the joints are made some cities put only a light earth covering over the pipe until it is evident that no joints are defective, elsewhere the trenches are backfilled immediately in perfect confidence as to tightness. Full pressure is put on the mains in from 12 to 48 hr. On the Los Angeles system cement joints put in twenty years ago are still in service. A citation of the average rate at which cement joints can be made was that one man would make twelve 12-in. joints per 8 hr. and other sizes in direct proportion.

Leadite joints are popular and are used extensively. They were reported difficult to make satisfactorily when the pipe is wet. A typical construction rate for leadite joints on 6 to 8-in. pipe was reported from Sacramento, where a 5-man pipe crew took pipe off the bank and completed the construction of the line at the rate of 900 to 1,200 ft. per day, the equivalent of a labor cost of about 2¾c. per foot.

Service Installations

In the symposium on service installation methods and standards many cities reported methods and solutions, particularly suited to their own problems. San Diego has an "active" water which gives much trouble from tuberculation; in some instances, a 4-in. main being choked down to the carrying capacity of a 1½-in. line. This difficulty is so serious that lead or brass pipes are now used in all services in that city.

Other cities have their most serious trouble from external causes, particularly where the chemicals of adobe soils attack the pipe metal. Cast iron of the larger mains does not give trouble but galvanized pipe is unsatisfactory and in some cases plain dipped pipe is attacked and destroyed in less than a year. Here again lead pipe in service sizes is a solution, San Diego reports some lead pipe in such soils still in good condition after 30 or 40 years of service.

In the matter of taking off services from mains there was general discussion on the preference between corporation cocks tapped directly into mains and the use of saddles banded to the mains. Some cities use saddles exclusively; others use them for large size service connections only, tapping in corporation cocks for small services. One city uses corporation cocks exclusively for connections up to 8 in. in diameter and in several thousand such installations has never had a case of cracking the main.

Question was raised as to how to make 1 to 3-in. service connections on a riveted steel pipe in which the flow could not be interrupted for such purposes during the irrigation season. Electrically welding a coupling to the pipe in service and then using a standard tapping machine was the method used in one city while another, not having enough of this work to warrant the purchase of a welding outfit, made such connections by placing a steel band around the pipe to be tapped, leading this in place and then using a standard tapping machine.

Larger Service Pipes and Meters

The need for changing to larger house services was noted in connection with the use of larger quantities of water in modern homes. Where ¾ in. was ample in the early days of San Francisco, ¾ in. is sometimes not enough now. This change is not only in modern plumbing fixtures: for example, the built-in type of lawn sprinkler with which an entire lawn is simultaneously watered not only taxes the individual service but in districts where generally used may make the service main unable to meet peak demands. This particular convenience does not increase the total quantity of water consumed and it is a load that comes only on the summer peak.

In contrast to this need for larger services a note of warning was sounded against extremes. Care should be taken not to install meters larger than really needed. Otherwise there will be excess slippage in the oversizes. By way of showing how large a quantity may be supplied through small meters the records of three ¾-in. meters on the San Francisco system were cited; these meters are regularly recording monthly deliveries of 34,000, 60,000 and 140,000 cu.ft., respectively.

City Engineer's Dismissal Upheld by Court

Office of City Engineer, North Adams, Mass., Held to be Subordinate Under Present Charter

The Supreme Court of Massachusetts in an opinion made public on Oct. 17 dismissed the petition of Charles E. Wells, former city engineer of North Adams, to have the commissioner of public works restrained from removing him from office and from interfering with his conduct of that office. The particulars of the case were described in *Engineering News-Record*, Aug. 27, 1925, p. 350.

Mr. Wells had taken the office under civil service rules which required a probationary period of six months service before the appointment became permanent. There occurred a change in the city administration and Mr. Wells was dismissed several days prior to the expiration of his six months probationary period. It is upon this fact that the court bases the legality of Mr. Wells dismissal contending that until after the six months period expires no protection can be claimed under the tenure of office provisions provided by civil service rules.

The supposed illegality of the dismissal rested upon the contention that the office of city engineer was an administrative and not a subordinate one. Two sections of the city charter are at variance on this point and the supreme court states that in its opinion a revision of the charter in 1918 in which the city engineer was left out of the list of administrative offices takes precedence over a former section which clearly states that the city engineer is an administrative officer. The office of city engineer in North Adams is now, in reality subordinate to that of the commissioner of public works, a political office. An editorial in the North Adams *Transcript* Oct. 19 says in this connection, "Now that the question has so emphatically been brought to public attention, however, it is our belief that most thoughtful people who, with changing conditions, appreciate the ever-increasing importance of a competent municipal engineering department, will believe that those who originally framed the charter were wiser than those who amended it on this point. Sound construction requirements and the best engineering practice in public improvements are matters of technical knowledge and experience, and they ought to be under full control of a man who has that knowledge and experience, who is protected from political pressure, and who can, therefore, call his soul his own."

Work Starts on Quebec Terminals

Work has been commenced on the first section of the new harbor terminals at Quebec, which are to cost about $2,500,000. Twenty million feet of Douglas fir timber is being brought from British Columbia to be used in the construction of the crib work. The contract is in the hands of the Northern Construction Co. and will take three years to complete.

WASHINGTON NOTES

THE SECRETARY of the Interior and the Commissioner of Reclamation figuratively will come before the bar of the next Congress for a vote of confidence. In this case the action is expected to be just as definite as would be the case were our deliberative Congress organized on a parliamentary basis. These officials have essayed to follow a bold policy with regard to relief and collections on federal reclamation projects. The opposition has crystallized definitely and apparently nothing can prevent a clear-cut determination of the issue involved.

Secretary Work and Commissioner Mead will insist that Congress support them in their opposition to moratoriums and any form of blanket relief, or that refunds be made to those who have paid, so that equality of treatment may be accorded to all. They will not be parties to any policy which writes off the debts of those who have made no effort to pay and who are able to pay. They are ready to meet in a finish fight those members of Congress who are giving support to agitators who are striving for the postponement or the forgiving of debts.

It is safe to say that both the Secretary and Dr. Mead will point out to the committees of Congress that the experience of the past does not indicate the success of a generous policy. Each moratorium has been followed by strengthened resistance to payments when the time for the payment arrived. They will be able to establish that the speculator who wishes to escape payments opposes paying, when the end of the deferment period comes, even more strongly than he did before it begun. Moreover, these officials are in a position to prove, it is believed, that those who pay usually are those that are having the hardest struggle. They will represent that federal reclamation as a whole is not likely to be continued if the people on reclamation projects are to be treated as the favored class to receive aid and support which the government does not give to the great bulk of the people in an arid state.

Secretary Work and Commissioner Mead will be able to point to the experience of the federal land bank at Spokane. Due to the ease with which reclamation obligations were deferred the Spokane bank has had the greatest difficulty in Oregon, Idaho and Washington in making its collections. The spirit of repudiation in the Northwest was so strong that the bank had to take drastic measures and was compelled to institute wholesale foreclosures. It will be brought out clearly that the fundamental question involved is whether the Bureau of Reclamation is a political or a business institution.

THE application of the Alabama Power Co. for a license covering its "old No. 18" on the Coosa River has been granted by the Federal Power Commission. The company proposes to construct a gravity-type concrete dam 100 ft. high and 2,100 ft. long. The power house is to be an integral part of the dam, where 180,000 hp. ultimately will be installed. The reservoir to be created will be eighteen miles long, backing the water as far up as the Mitchell dam now being operated by the company.

ON THE very day of the expiration of the legislative extension of the preliminary permit of the Dixie Power Co. to develop power on the White River in Arkansas, a new application was filed by the White River Power Co., of Little Rock, Ark., of which Hugh L. Cooper is the consulting engineer. The new application provides for two dams in the White River and mentions the possibility of the need for six other dams in order to secure the maximum utilization of the river. It is estimated that equipment capable of generating 250,000 hp. can be installed to advantage.

Another application for the same site was filed by the Ozarks Hydro Electric Power Co. also of Little Rock. The company proposes to construct one dam in the White River, one in the North Fork of the White River, and a third in Buffalo River. In that way it expects to develop 208,677 hp. This project is more extensive than that covered by the preliminary permit held by the Dixie Power Company.

A LICENSE will be issued to the Nevada Irrigation District for the utilization of the waters of the Middle Yuba river in California. This course was decided upon at a meeting of the Federal Power Commission Oct. 3. The Yuba River Power Co. was an applicant for the same rights. It was able to establish that it was in a position to utilize the water with greater efficiency than could the irrigation district insofar as the generation of power was concerned. It was charged that the water could not be used to advantage for irrigation and that the real purpose of the irrigation district was to secure the water for the revenue it would produce through its use for power purposes.

The commission was convinced that the Nevada Irrigation District could not finance its project at present without the waters of the Middle Yuba. In as much as the state already had taken action, the commission did not feel inclined to reject the application of the irrigation district. The difference between the two proposals was not particularly marked when the economics of the entire situation were considered, it was stated at the offices of the commission.

REAPPOINTMENT of General Mason M. Patrick for another term as chief of the Air Service insures his retirement with the rank of major general. Had General Patrick not been reappointed he would have reverted to his regular rank which is that of colonel in the Corps of Engineers. He will reach the retirement age December 13, 1927, which will be within the limits of the new term as chief of the air service.

Chicago Gets Preliminary Port Report from General Black

Antiquated as an 1880 locomotive Maj. Gen. W. M. Black calls the port facilities of Chicago, particularly the Chicago River, in a preliminary report presented to Col. A. A. Sprague, commissioner of public works and head of a port commission formed last year. General Black was called in to state the problems which the port commission must study before laying down a policy. Such a policy is necessary before the War Department will give permits for further bridges to be built over the Chicago River, since that policy will determine whether fixed or movable bridges are to be built.

Twenty different topics for study are indicated as necessary "to form a project for port betterment at Chicago which will be truly economical and advantageous." Among these are the following: Present use, existing facilities and connections, dependent territory, relation to other carriers, territory to be covered, materials to be handled, relative costs, savings to railroads, probable commerces on Illinois Canal, types of carriers, intraport lighterage, grain facilities, shipyard facilities, lake front available, approaches, storage, rail belt lines, relation to city zoning, subways, wharfage charges, design and organization duties.

Engineer Running for Buffalo City Commission

George C. Andrews, water commissioner and engineer filtration division of the Bureau of Water, Buffalo, N. Y., is one of the candidates for membership in the city commission or council at the election Nov. 3. Mr. Andrews was appointed supervising engineer of the Bureau of Water in 1916, when the commission plan of government came into effect, and later was appointed to the positions he now holds. He was formerly a resident engineer on the New York Barge Canal. His campaign committee urges that Mr. Andrews is saving the city $1,000,000 on the construction of the water filtration plant, for which an appropriation of $4,500,000 was made.

Proposed Raising of Rainy Lake Meets with Strong Opposition

The proposal of certain power interests headed by E. W. Backus to raise the level of Rainy Lake and adjoining waters on the international boundary between Minnesota and Ontario met with considerable opposition at the hearing of the International Commission held at International Falls, Minn., recently. The principal objectors were the Canadian National Rys. and the town of Port Frances. The Canadian National Rys. would be required to raise a 24-mile stretch of track about 4 ft. and the town of Port Frances would lose part of its municipal park and would have its sewage system endangered.

Rochester, N. Y., to Vote on Council-Manager Plan

Amendments to the city charter of Rochester, N. Y., providing for the council-manager plan of government are to be voted on at the general election Nov. 3. If the plan is adopted, there will be a council of 9 members, 5 elected at large and 4 by districts, each to serve four years at a salary of $1,500 a year. The council would select a mayor who might or might not be one of its own members, a vice-mayor who must be a member of the council, a city clerk, each for two-year terms, and a city manager, the latter "upon the basis of his executive and administrative qualifications without regard to his political party affiliations," subject to suspension or removal at the pleasure of the council.

The city manager would have the usual powers of such officials, including the appointment of department heads and members of several commissions. In general, subordinate officials would be appointed by department heads, but subject to the approval of the city manager.

There would be four administrative departments: Finance, Public Works, Public Safety, and Law. Under the Finance Department there would be a purchasing agent. The Department of Public Works would be headed by a commissioner who would have charge of all the public works and buildings of the city except school buildings, and who would also have power to fix water rates, but subject to the approval of the city council. Under the commissioner of public works there would be a director of design and construction and a director of maintenance and operation. No qualification for the latter is named, but the director of design and construction would have to be a licensed civil engineer who had spent not less than 10 years in the practice of his profession. This director would "act in all cases as the city engineer and as the deputy commissioner of public works."

The proposed amendments provide for a city planning commission, a civil service commission, a municipal museum commission, and "such citizens advisory board as the city manager may require"; also public library trustees.

If approved on Nov. 3, the charter amendments outlined above will become effective Jan. 1, 1928.

American Road Builders Make Official Nominations

The American Road Builders Association's nominating committee has submitted the following names as the official nominees to be elected at the meeting of the association to be held at Chicago January 7: For president, H. G. Shirley, Chairman of the Virginia State Highway Commission; for vice-presidents, W. R. Smith, S. T. Henry, S. F. Beatty and Samuel Hill; for directors, term ending 1929, W. H. Kershaw, C. M. Pinckney, Frederic A. Reimer, R. Keith Compton, Chas. M. Upham, Wm. Ogden and Frank Terrace.

Roadmasters Discuss Broader Aspects of Track Work

The broader aspects of maintenance-of-way rather than the details of routine track work were featured at the annual meeting of the Roadmaster & Maintenance-of-Way Association, held at Kansas City in September. Individual papers included: "The Essentials of Maintenance-of-way," by C. E. Johnston, vice president and general manager, Kansas City Southern Ry.; "Treatment of Soft Roadbed," A. N. Reece, chief engineer, Kansas City Southern Ry.; "The Roadmaster's Opportunity for Constructive Service," by L. W. Baldwin, president, Missouri Pacific Ry.; "Railroading," by W. B. Storey, president of the Santa Fe Ry. System, and "Raising the Standard of Maintenance Forces," by F. W. Green, vice president of the St. Louis Southwestern Ry. Committee reports dealt with the following subjects: (1) The programing or scheduling of maintenance work; (2) methods and costs of weeding track; (3) means of prolonging the life of rails; (4) the roadmaster's responsibility for proper relations between the railways and the public.

For the 1926 meeting, to be held at Chicago, the subjects for committee reports are as follows: (1) Rail joints and their maintenance; (2) the arrangement of track work to promote the employment of uniform forces throughout the year; (3) the construction, maintenance and protection of highway crossings; (4) cost data of maintenance work; (5) repair of track tools. The secretary's report showed a membership of 1,023. Officers for the ensuing year include: President, G. W. Morrow, supervisor, N. Y., N. H. & H. R.R.; vice presidents, J. B. Kelly, general roadmaster, Soo Line, and J. P. Davis, engineer of maintenance-of-way, Central Indiana R.R.; secretary, T. F. Donahoe, general roadmaster, B. & O. R.R., Baltimore, Md.

Contract Let for Important Power Development in Maine

Contract for the construction of a 50-ft. concrete dam across the Androscoggin River in Maine and the construction of a power house on the Lewiston side at Gulf Island, Me., 5 miles above Lewiston, has been let by the Central Maine Power Co.; 27,000 hp. will be developed at the site. This will be the second largest development in Maine. A short branch-line railroad will be built to the site in order to facilitate the movement of material and machinery. The contract was let to the Morton C. Tuttle Co. of Boston.

Atlantic Coast Line Ry. to Build Short Railroad

The Atlantic Coast Line Railroad Co. has been authorized by the Interstate Commerce Commission to build a branch line railroad from its southern terminus at Immokalee, Fla., in a general southerly direction to Deep Lake, a distance of approximately 27 miles, all in Collier County, Fla.

Random Lines

Why Upkeep is High

Says the *American Lumberman:*

We remember one time we were watching a binder working on a farmer's place, and he turned to us and said: "It's a wonderful machine, isn't it? It just seems to have human intelligence!"

"Oh, I wouldn't say that," we replied. "I was past this place last spring and I noticed the darned thing didn't even have enough sense to come in out of the rain."

For "farmer" read "contractor" and for "binder" read "grader," and the story would be just as true.

* * *

The Draftsman's Goal

By Elldee

We'd just paid for six tons of coal, so naturally went on a stroll, deducing that the good, fresh air would drive away the lines of care that erst had sprouted on our brow and made us sadder than a cow about to face the butcher's mace and journey to the other place. In course of time we reached a stump located in a grewsome dump—the city's necessary blight—and "set up" there to "take a sight." Among the bed slats, cane and bricks and busted bottles, ticks and sticks, old trunks, wash bowls and defunct pants, a forlorn object caught our glance that drew from us a heartfelt sigh and brought a hot tear to our eye. An old stool, somewhat like the one we've occupied since time begun before a bleary drawing board, with calloused elbows, aching gourd and ink stained mitts and quaking knees pursuing contours o'er the leas and "rubbing out" and "inking in" to cinch our meagre meed of tin. Its rungs were almost worn clear through from contact with some draftsman's shoe. The legs were held intact with wire, recalling Aesop's trusty lyre on which he thrummed his sad, sweet tunes long ere they knocked out juice of prunes. The seat shone like a looking glass—the whole had reached a sorry pass—and as upon its wreck we gazed the tragedy our senses dazed! For doubtless somewhere in the dump stretched out or planted in a lump its erstwhile occupant, poor soul, had reached at last the draftsman's goal!

* * *

Engineering in the Small City

"BRIDGEBURG, Ont., Oct. 8—Town Engineer E. B. Hubbard of Bridgeburg has in his garden on Lewis Street what is believed to be the premier curio of the year—a monster bean.

"The bean, of the climber variety, is exactly 50 inches in length, and eight inches in thickness. It weighs about ten pounds.

"The specimen will be exhibited at harvest home services to be held in a Bridgeburg church on Sunday."

Natron Cut-Off to Open in 1926

According to a statement by H. W. deForest, chairman of the executive committee of the Southern Pacific Co., Natron cut-off, the new line which the Southern Pacific is building in Oregon, including the cut-off from Black Butte to Grass Lake, will be ready for operation by the end of July, 1926. It is expected that the total capital expenditure on this work will amount to $23,000,000 by the time it is completed.

Engineering Societies

Calendar

Annual Meetings

ASPHALT ASSOCIATION, New York City; Annual Paving Conference, Detroit, Mich., Oct. 21-23, 1925.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, Lakeland, Fla.; Annual Meeting, Des Moines, Iowa, Oct. 26-30, 1925.

CITY MANAGERS ASSOCIATION, Lawrence, Kansas; Annual Convention, Grand Rapids, Mich., Nov. 17-19, 1925.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS, Washington, D. C.; Annual Convention, Detroit, Mich., Nov. 18-20, 1925.

HIGHWAY RESEARCH BOARD, Washington, D. C., Annual Meeting of the Highway Research Board, Washington, D. C., Dec. 3-4, 1925.

AMERICAN ROAD BUILDERS ASSOCIATION, New York City; Annual Convention, Chicago, Ill., Jan. 11-15, 1926.

The National Rivers and Harbors Congress will hold its 21st annual convention at Washington, D. C., Dec. 9 and 10, 1925.

The New England Section, Society for the Promotion of Engineering Education, met at Barre, Vt., and later at Norwich University at Northfield, Vt., on Oct. 10.

The Highway Research Board, National Research Council, at its annual meeting to be held in Washington, D. C., Dec. 3 and 4, will be addressed by Thomas H. MacDonald, of the U. S. Bureau of Public Roads, on the morning of Dec. 13 and will devote the remainder of the two days to the hearing and discussion of committee reports.

Personal Notes

COL. W. A. MCCALLA, for a number of years principal assistant state highway engineer, was elected state highway engineer of Alabama by unanimous vote of the new highway commission, Oct. 16. He succeeds the late W. S. KELLER. Colonel McCalla was born at Chester, S. C. He has been in engineering since he left the University of Alabama in 1886. Since August 1, 1919, he has been with the Alabama state highway department as principal assistant highway engineer, prior to that he had been senior highway engineer with the United States bureau of public roads, quitting this position to participate in the World War. He served in France with the 504th Engineer Service Battalion and was promoted overseas from major to lieutenant colonel. He was decorated by the French for his conspicuous service and made chevalier of the Legion of Honor.

R. PLATT BOYD and LANDON G. SMITH have been appointed members of the Alabama Highway Commission. Mr. Boyd, the commissioner of maintenance, is a native of Montgomery, Ala. He served with the state highway department from the establishment of the department in 1911, as the only assistant of the late W. S. Keller, until 1916, when he removed to Louisiana and engaged in engineering work there. He returned to Alabama in 1920 and again entered the service of the state highway department. At the time of his appointment he was assistant state highway engineer in charge of maintenance.

Associate commissioner Landon G. Smith was born at Tuscaloosa. He has been with the Alabama state highway department for six years, serving first as office engineer then promoted to bridge engineer and finally to chief locating engineer, the position which he held when appointed on the commission.

Captain Smith is a World War veteran, having served in France with the Second Engineers, as captain.

JOHN B. EMERSON, engineer of tests of the Rail Committee of the American Railway Association, has been elected vice-president of R. H. Laverie & Sons, Inc., inspectors of materials. Mr. Emerson will assume charge of the Chicago office. He has been identified with the inspection of materials field of engineering for many years.

MAJ. JAMES W. BAGLEY, Corps of Engineers, stationed at Fort Humphreys, Va., has been detailed to duty involving flying for the purpose of experimenting in aërial mapping and testing photographic instruments used in that work.

E. F. JOHNSON, formerly chief draftsman in the city sanitary engineer's office at Grand Rapids, Mich., is now in charge of the Tarpon Springs, Fla., branch office of the Hunter Engineering Co., civil and landscape engineers of Tampa, Fla.

ERNEST LANGFORD has resigned his position as an assistant professor of architectural construction in the University of Illinois to accept a full professorship in the Texas Agricultural and Mechanical College, College Station, Texas.

W. H. FINLEY, whose resignation as president of the Chicago & Northwestern Ry., was noted in these columns July 2, p. 31, has opened an office for practice as a consulting engineer at 1,102 Chamber of Commerce Building, Chicago. Mr. Finley's professional career including his 13 years as bridge engineer and chief engineer of the road of which he finally became president is given in the former notice.

Obituary

NELSON DANA MILLER, formerly chief engineer of the Great Northern Railway Co., died at St. Paul, Minn., Oct. 9, 1925, in his 81st year. Mr. Miller was born near Vernon, Vt., and came to St. Paul with his parents when a small boy. He was educated in the public schools of St. Paul, began work on a government survey in 1863 and in 1864 joined the Engineering Department of the Lake Superior & Mississippi R.R. and continued in railroad survey work and construction on various roads until in 1877 he became resident engineer on the St. Paul & Pacific R.R., a part of the Great Northern. From 1879 to 1885 he was chief engineer of the St. Paul, Minneapolis & Manitoba R.R. (now part of the Great Northern R.R.) and from 1885 to 1895 and from 1898 to 1899 was chief engineer of the Great Northern. From 1905 to 1908 he was chief engineer of the Spokane, Portland & Seattle R.R. and from 1910 to 1911 assistant engineer of the highway department of the State of Washington locating roads. In 1915 he retired from active life.

BRIGADIER-GENERAL H. N. RUTTAN died at Winnipeg, Manitoba, Oct. 13, in his 78th year. In the early days, General Ruttan held many important engineering positions with the Grand Trunk, Intercolonial and Canadian Pacific Railways. In 1874 he made the first surveys for the Canadian Pacific along the North Shore of Lake Superior. For 29 years, from 1886 to 1915, he was city engineer for Winnipeg.

ALBERT FRANKLIN SICKMAN, chief hydraulic engineer of the Holyoke Water Power Co. since the death of his brother, James M. Sickman, died suddenly of heart disease in that city Oct. 17, at the age of 68. He entered the employ of the company in 1878, upon his graduation from the University of Pittsburg, and soon took a responsible part in the hydraulic department in association with his brother and Clemens Herschel. He was an associate engineer in building the large dam at Holyoke, and was active in the company's service until his death.

HARRY B. HANGER, president of Mason, Hanger & Co., of Lexington, Ky., contractors, died Oct. 7 at the home of his business partner, Mr. Mason, near Lexington, of heart disease, at the age of 60 years. Mr. Hanger's company built two sections of the Catskill aqueduct for New York City water supply and some two miles of New York City's subways; shipping terminals at Charleston, S. C., in Rhode Island, and at Newark, N. J.; and during the War directed the work of construction of Camp Taylor at Louisville, Ky.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

U. S. Supreme Court Closes Case on Trade Association Status

The United States Supreme Court, Oct. 12, refused to grant a petition for rehearing filed by the government in the Maple Flooring Manufacturers' Association and the Cement Manufacturers Protective Association cases. This action definitely closes the proceedings.

It was in these two cases, decided against the government, that the Supreme Court last spring laid down its important decisions defining legal and illegal trade association activities, particularly with reference to the collection and dissemination of statistics, and thereby removed the uncertainty which has surrounded such association work for several years.

Immediately after the decisions in the spring, the Department of Justice announced that it would accept the principles laid down by the Court, but would move for a rehearing in these specific cases on the ground that the evidence showed that the two associations had committed illegal acts within the principles announced by the Court. The Court evidently took the contrary view of the matter.

Exhibit Space at Western Road Show "Sold Out"

The 140,000 square feet that will be available for exhibitors under canvas at the first All-Western Road Show, to be held in San Francisco, Nov. 9-14, has been all sold according to a recent announcement of the general committee. In addition to the exhibit space under canvas the area available for open-air demonstrations comprises some 25 acres. A previous announcement about the show appeared in *Engineering News-Record*, Sept. 24, p. 528.

A series of meetings in connection with the road show has been scheduled with programs and papers arranged under the following general classification: Nov. 9, Western Association of State Highway Officials; Nov. 10, Western Construction Equipment Distributors; Nov. 11, Western States County Officials Association; Nov. 12, Western Contractors; Nov. 13, Pacific Coast Sand & Gravel Association.

These meetings will be held in a frame building on the show grounds which has a seating capacity of 2,000. The concluding feature of the show will be a banquet at the Fairmont Hotel on the evening of Friday, Nov. 13.

Trade Catalogs Wanted

The Australian Commonwealth Engineering Standards Association, 16 College Street, Sydney, is desirous of being placed on the mailing list of American manufacturers who issue catalogs that are of interest to the engineering and allied professions. The catalogs are for use in the Association's library.

Barium-Treated Clay Veneer Placed on Bricks

Automatic machinery has been devised which places a veneer of barium-treated clay on untreated clay in the making of bricks. The addition of barium to certain clays is necessary to prevent effloresecing, and until recently the whole brick had to be made of this barium-treated material. With the new machinery only 10 per cent of the clay has to be thus treated, thereby reducing considerably the cost of the finished product. It is also claimed that this new machine makes it practicable to place feldspar surfacing on bricks.

Bulk Cement Transported in Steel Barges

The transportation of cement in bulk will shortly be inaugurated by the International Cement Corporation in order to effect the economies that this method affords. The cement will be transported from the plant of the Cuban subsidiary of the International system at Mariel Bay to the company's warehouse in Havana, a distance of 25 miles, by a steel barge approximately 162 ft. long by about 34 ft. beam. Twenty bins, ten on either side of the vessel, have a combined capacity of 5,000 bbl. of cement.

The cement will be pumped into these bins from the storage supply at Mariel through an 8-in. pipe 800 ft. long. Separate outlets from this main pipe distribute the cement to each of the 20 bins. When the barge reaches the docks in Havana the cement will be pumped from the barge to the top of storage bins 80 ft. high. Unloading will consume about six hours and about the same time will be required to load.

Business Notes

C. V. ALLEN, formerly manager, Westinghouse Electric International Co. in Mexico, has been elected assistant treasurer of the company with headquarters in New York City. Clayton T. Rogers, sales manager for the Mexican branch, has been named acting manager succeeding Mr. Allen. Mr. Allen has been with the Westinghouse organization for 30 years and assumed the managership of the branch division in 1921. Mr. Rogers, who succeeds him in Mexico City, served as special representative of the company in Peru and Mexico before being made sales manager of the Mexican branch.

ROBERT W. HUNT CO., engineers of inspection and tests, announce the opening of a branch office and cement laboratory in Birmingham, Ala. T. C. Peace is resident manager.

W. B. LOUER CO., the distributor for the Caterpillar Tractor Co. in northern Illinois, will move on Nov. 1 to new quarters at 1512 South Michigan Blvd. The move to larger quarters is said to be due to greatly increased operations and additions to its lines of construction equipment.

BROWN, BOVERI & CO., LTD., Baden, Switzerland, one of the largest of the European manufacturing organizations, announces that an American organization will soon be established to manufacture electrical equipment under its patents and designs. The new organization is to be financed by American capital and is said to be distinctly an American enterprise. Brown, Boveri products include electric motors, electric drives in industrial plants, turbo compressors and blowers, ship propulsion machinery and complete equipment for water power projects, steam generating stations and electric railways.

DEAN K. CHADBOURNE has been appointed general manager of the Westinghouse Electric International Co. to succeed E. D. Kilburn who was recently elected vice-president of the Westinghouse Electric & Mfg. Co. Mr. Chadbourne was born in Elmira, N. Y., and graduated from Purdue University in 1906 with a degree in electrical engineering. He was for six years connected with the Chicago office of the Allis-Chalmers Co. and then became district manager of the George Cutter Co., South Bend, Ind. He joined the Westinghouse Electric International Co. in 1920 as manager of the far eastern department.

FRED G. SYBURG, assistant to the export manager of the Chain Belt Co., Milwaukee, Wis., will spend a year touring the Orient and countries of the Far East in the interests of the company. Mr. Syburg will spend several months with foreign representatives in China, Japan, India, Australia, and the Dutch East Indies.

PARADON ENGINEERING CO., Long Island City, N. Y., announces the appointment of E. L. Sandberg as its representative in the states of Minnesota, North Dakota and South Dakota, with offices in Minneapolis.

DETROIT STEEL PRODUCTS CO., Detroit, Mich., has opened an office in Miami, Fla., for the sale of Fenestra windows. Joseph Nadler has been appointed manager.

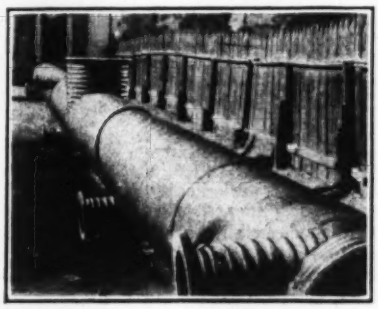
D. S. BRIGHT, former manager of the Cleveland office of the Concrete Steel Co., New York City, is now manager of the company's combined Pittsburgh and Cleveland offices in

Pittsburgh. J. W. Peoples, the former manager of the Pittsburgh office, has resigned but will retain a connection with the company, acting as its agent in West Palm Beach, Florida.

Equipment and Materials

Diesel Engine Exhaust Manifold Made from Corrugated Steel

A large manifold for controlling the noise from an installation of six Diesel engines, two each of 500, 750, and 1,000 hp., was recently constructed at El Paso, Texas. The noise from these engines could previously be heard within a 3-mile radius. The manifold is made of 12-gage Armco corrugated

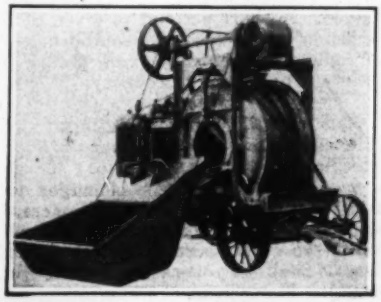


iron sheets and is 36 in. in diameter, 104 ft. long, and has a 50-ft. stack attached; all joints are close-riveted and soldered and the tees are welded. The exhausts from the engines enter the manifold in such a manner that one exhaust counteracts another, thus breaking the rotation of the gases and deadening the noise. A heater was placed between the manifold and the stack for utilizing the heat of the exhaust gases, which have a temperature of from 600 to 800 deg. F.

The manifold was designed by Mr. Chapman of the engineering firm of Sanderson and Porter, El Paso, Texas.

Loading Skip and Discharge Chute Synchronize on New Mixer

Synchronized action between the charging skip and the discharge chute, which enables the machine to discharge concrete while the skip is charging the drum with aggregates, is one of the special features of the 14-S mixer which represents the latest development in concrete mixers manufactured



by the Chain Belt Co., Milwaukee. An automatic clutch knockout is so arranged that when the loaded skip reaches its proper discharging height, the clutch is disengaged and a brake automatically set. This feature relieves the operator and allows him to devote all his time to discharging, thereby taking full advantage of the synchronized action. The countershaft is mounted on a ball and socket arrangement that adjusts itself to shaft misalignments caused by working on uneven ground.

Discharge of the material from the mixer can be effected from either side through a geared discharge mechanism with a large handwheel; a quick turn of the handwheel puts the chute in discharging position. A short chassis with automobile type steering knuckles aids portability. Power is supplied by a 15 hp. four cylinder LeRoi gasoline engine. This mixer was tested on construction work for over a year and is now put on the market as a two bag machine on a 1:3:6 mix or three bag machine on a 1:2:5 mix.

Vest-Pocket Level Has Dual Use

A small hand level, having a special shaped aluminum casing around the level glass may be used for either line or surface leveling. Small hooks are provided for attaching the level to a

line while its curved bottom permits it to be used on either a plane or circular surface. The end pieces and the hooks are formed from one piece of nickel silver and attached to the aluminum casing by nickel silver rivets. The level is 3 in. long. It is manufactured by E. A. Stevens, Newton Falls, Ohio.

Sanitary Ash and Garbage Truck for City of Boston

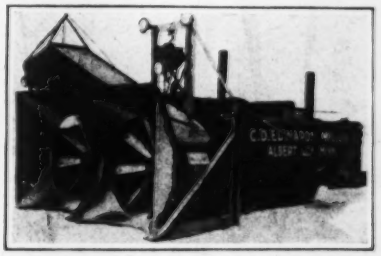
The accompanying illustration shows the new garbage and ash truck recently ordered by the city of Boston. This piece of equipment is claimed to result in a saving of both time and labor in addition to its obvious advantage in minimizing the obnoxious odors and dust incident to many present methods of refuse collection. The loading hopper on the curb side of the truck is 9 ft. long by 20 in. high in front and in its lowest position is 30 inches above the street. Refuse to the amount of about 12 ordinary cans is dumped into this hopper after which it is raised on the rail track and dumped. The bucket operates from a power take-off controlled by a lever in the driver's seat. It has a lifting capacity of 2,500 pounds which is double the capacity required when filled with dry ashes. As a safety measure against overloading a special patented friction clutch is used which automatically slips when the load is greater than 2,500 pounds.

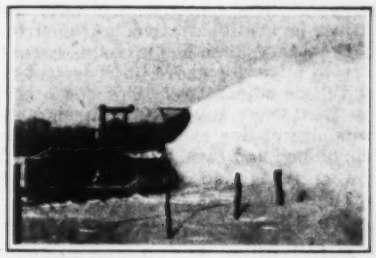
The body tank is entirely enclosed and has a capacity of 9 cubic yards; it is 3 ft. 10 in. wide and 11 ft. long. The hood at the top encloses the open end of the bucket while dumping or while not in use. The body is dumped

by hoisting the front end and permitting the contents to slide out of a hinged door in the rear. Only two men are required to operate this equipment and the work is done much more rapidly because of the ease of placing the refuse in the truck. This equipment is manufactured and patented by Auto Truck Industrial Appliances, Inc., New York City.

Rotary Snow Plow for Highway Use

A rotary snow plow that distributes snow from 100 to 300 ft. outside of the right-of-way is a new product of the C. D. Edwards Mfg. Co., Inc., Albert Lea, Minn. Although rotary plows have been in use on the railroads for many years, most of the so-called rotary highway plows have heretofore been a combination of the rotary type and V-type plow. This new plow is built completely around a 10-ton Holt tractor and is so constructed that its front may be raised to any height up





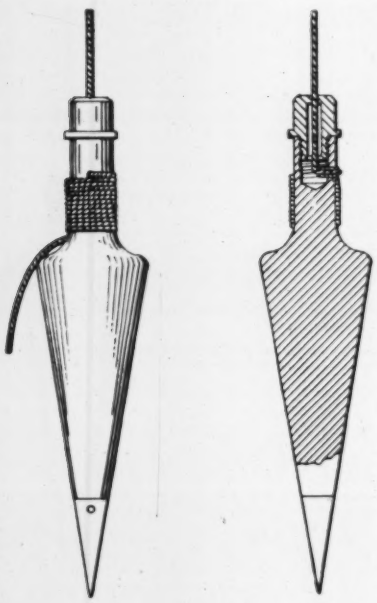
to 2 ft. from the ground. This adjustment allows the operator to leave any desired thickness of snow on the roadway.

The rotors of the plow are driven by a six-cylinder motor of 100 hp. which is independent of the tractor motor. When using a single engine for both rotor and tractor it is claimed that not a sufficient amount of reserve power is

available because each unit requires the maximum power at the same time. An adjustable baffle over the end of the blower directs the snow discharge to any required angle. The snow plow motor is controlled by an automatic governor that fixes the amount of gas required and keeps each rotor at an even speed whether throwing light or heavy snow; the operator of the outfit needs only to drive the tractor. The diameter of the rotor is 5 ft., while the overall length of the outfit is 19½ ft. Alemite lubrication is used throughout and generator, storage battery and self-starter are standard equipment. The weight of the snow plow without the tractor is 8 tons.

Plumb-bob May Be Quickly and Accurately Adjusted

A plumb-bob with an adjustable line which makes it easy to drop the bob accurately on the mark has just been put on the market by F. J. Bernard, 607 Stock Exchange Building, Portland,



Oregon. The mechanical details are shown in the illustration. Around the neck of the plumb-bob is wound enough line to allow for about three feet of up and down adjustment. This line is held by friction at any point. Turning the windings of line to the right raises the plumb-bob and turning them to the left lowers it. In all other particulars it is standard in size and weight.

Self-Drilling Expansion Shells Suspend Hangers

A self-drilling expansion shell for fastening pipe hangers and other equipment to concrete ceilings is manufactured by the Phillips Drill Co., Chicago. It consists of two pieces, the shell and the tapered plug or expander. The lower end of the shell is arranged for engagement with a suitable holder for drilling and for attaching various devices thereto, after the removal of the holder. The shell shown in the illustration is threaded for a rod hanger. A hole drilled through this lower end takes a cotter pin or cross-bolt for attaching pipe and strap hangers.

For installing, a few blows of a hammer drills the shell into depth. It is then pulled, the tapered plug inserted and both are replaced and driven into the hole. The plug expands the shell larger than the hole through which it was inserted insuring it against pulling out. A special spring hammer which also pulls the shell from the hole after drilling is made especially for installing these expansion hangers.

Electric Light Bulb Is Frosted on Inside

The frosting of the bulb on the inside in such a manner as to provide diffusion by refraction of the direct rays is the main feature of the new standard line of lamps manufactured by the Westinghouse Lamp Co. The new line will consist of five sizes of lamps and will replace a number of the forty-five lamp types of 100 watts and under now in common use. The first of the line, a 25-watt lamp, has already been placed on the market. It is claimed that tests show that not only is the initial loss by absorption less than 2 per cent of the light output, but the loss during life is much less than that of other diffusing finishes. The bulb is highly polished on its exterior and thus does not collect dust and dirt so readily as an outside coated lamp. The bulb has the shape naturally taken by a falling drop of water. This new line of lamps is introduced in connection with the company's endeavor to standardize its output and reduce the number of excess varieties.

Publications from the Construction Industry

Surveying Instruments — THE A. LIETZ CO., San Francisco, has recently issued the 15th edition of its catalog in 500 pp. Besides describing in detail all engineering, surveying, mining and nautical instruments and materials manufactured by the company, the catalog devotes 50 pp. to remarks on the use, handling, care and adjustment of the instruments.

Electrical Supplies — Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has just made available its 1925-1927 catalog which supersedes the one for 1923-1924. The catalog contains 1,200 pp. and presents a complete listing of the apparatus manufactured by the company. In addition, brief descriptions are given of industrial motors, power and marine equipment, railway supplies, etc. A complete cross-index supplemented by thumb insets for the main sections of the book facilitates easy and rapid location of data.

Hoisting Machinery—S. FLORY MFG. CO., Bangor, Pa., has recently issued catalog No. 31 devoted exclusively to hoisting machinery for construction and material handling operations. The catalog contains 72 pp. and each type of equipment is illustrated and described.

Grab Buckets—HAYWARD CO., New York City, has just issued Bulletin 650 describing its Class E clamshell buckets and Bulletin 655 describing its line of orange-peel buckets. Both booklets, in addition to the descriptive text, contain several pages of construction illustrations in which the buckets are featured. A page at the back of each bulletin is devoted to photos and descriptions of details listed as special features of Hayward buckets.

Air Compressors — SULLIVAN MACHINERY CO., Chicago, continues its practice of periodically issuing 6x9-in. catalogs punched for binding, each catalog describing a specific line of the company's equipment. The latest catalog describes its portable air compressors, types WK-312 and WK-314. The former is a two-cylinder vertical type direct-connected to four-cylinder Buda engine and the latter a 220-ft. four-cylinder V-type. The booklet describes both machines in detail with text and illustrations, and, in addition, illustrates the various mounting available.

Track Jacks—TEMPLETON, KENLY & CO., LTD., Chicago, has published the report of the Underwriters Laboratories on its line of Simplex track jacks. The report covers the general character and use, assembly and operation, construction details, and methods of manufacture. Calibration and strength test data are included in tabular and graphic form.

Concrete Proportioning—BLAW-KNOX CO., Pittsburgh, Pa., in its new booklet on Batcherplants, describes its equipment for use in three different accepted methods of concrete proportioning—by volume, by inundation, and by weight. The three methods are described and information is given as to the use of equipment in each. Both portable proportioning plants and proportioning for large central mixing plants are discussed. A short account is given of a tendency noted for the establishment of commercial central mixing plants in different parts of the country.

Shovels and Cranes—KOEHRING CO., Milwaukee, has recently issued a 30-p. specification catalog on its No. 1 shovel-crane-dragline machine. All major details of the equipment are illustrated and described and diagrams and tables are given covering crane and dragline loads, radii of operation, and other working dimensions.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Decrease in Number of Failures Shows Upward Trend of Business

The number of commercial failures in the United States has decreased steadily from month to month, since April of the current year, according to latest reports of R. G. Dun & Co.

There were 1,465 defaults during September, 1925 which represents the smallest monthly total since a year ago, at which time there were 1,306.

The September liabilities of $30,687,319 were the smallest reported in two years and fell below those of the month preceding by more than 16 per cent. The amount of money involved in last month's failures is approximately 43 per cent below the high point for last year reached in January, and is 10 per cent under that for September, 1924.

Number of Failures

	1925	1924	1923
September	1,465	1,306	1,226
August	1,513	1,520	1,319
July	1,685	1,615	1,231
3rd Quarter	4,663	4,441	3,776
June	1,745	1,607	1,358
May	1,767	1,816	1,530
April	1,939	1,707	1,520
2d Quarter	5,451	5,130	4,408
March	1,859	1,817	1,682
February	1,793	1,730	1,508
January	2,317	2,108	2,126
1st Quarter	5,969	5,655	5,316

Liabilities by Quarters

	1925	1924
September	$30,687,319	$34,296,276
August	37,158,861	55,153,981
July	34,505,191	36,813,238
3rd Quarter	$102,351,371	$126,263,495
June	$36,701,496	$34,099,031
May	37,026,552	36,590,905
April	37,188,622	48,904,452
2nd Quarter	$110,916,670	$119,594,388
March	$34,004,731	$97,651,026
February	40,123,017	35,942,037
January	54,354,032	51,272,508
1st Quarter	$128,481,780	$184,865,571

The amount of indebtedness showed a decrease among manufacturers, while that for the class including traders, agents, brokers, etc. gained over the August, 1925 total.

Unit Prices on Recent Large Jobs

In the Oct. 15 issue, pp. 655 to 657, we tried the experiment of bunching the unit price lists on several large contracts. We will do this again if you want these data. We gather these lists on all kinds of work in all parts of the country. If you want them published please tell the

Construction News Editor,
Engineering News-Record,
Tenth Ave. at 36th St.,
New York City.

This Week's Contracts—Week Ago—Same Week Last Year

THE money value of contracts reported in the present issue of *Engineering News-Record* is here compared with the figures for corresponding weeks.

Minimum costs observed are: $15,000 for water-works and excavations; $25,000 for other public works; $40,000 for industrial and $150,000 for commercial buildings.

Money Value of Contracts Let—Entire U. S.

Week Ending	Public Work	Private Work	Total Contracts
October 22, 1925	$21,468,000	$31,088,000	$52,556,000
October 15, 1925	9,731,000	21,413,000	31,144,000
October 23, 1924	18,762,000	30,127,000	48,889,000
Heaviest Week			
1925, Sept. 3	16,215,000	69,424,000	85,639,000
1924, May 8	26,370,000	38,829,000	65,199,000
January 1 to Date			
1925	883,887,000	1,200,376,000	2,084,263,000
1924	830,231,000	857,108,000	1,687,339,000

Car Loadings Will Probably Remain Heavy While Building Boom Lasts

WEEKLY loadings of revenue freight are still running at around a million cars per week, as they have during this particular season of the year, for the past three years. The 1925 loadings to date are substantially ahead of any preceding year.

The seasonal movement of grains eastward and of coal westward, is evidently not entirely responsible for the heavy traffic, since the former showed a decrease during the last week on which reports are available.

The question comes up as to just what part in the present prosperity, is being played by building materials.

This class of freight, together with automobiles, probably forms the bulk of the miscellaneous loadings, which for the week of Oct. 3, represented about 40 per cent of the total weekly loadings and for the week preceding, 30 per cent.

The six other classes of carload-lot loadings are, grain and grain products, live stock, coal, coke, ore and forest products. Of these, the last mentioned class contains all the lumber used in construction.

If construction and the automotive industry contribute the bulk of the freight classed as miscellaneous and that classification is 40 per cent of total loadings, then the various industries that go to make up the other 60 per cent must be dependent to a very great extent upon these two.

Apart from loadings in carload lots, we have merchandise in less-than-carload lots. Heavy loadings in this classification reflect the prosperity of small shippers and factories not large enough to afford private freight sidings.

REVENUE FREIGHT LOADINGS—AM. RY. ASSOCIATION

	Sept. 26, 1925 Carloads		Oct. 3, 1925 Carloads	
Grain and grain products		55,199		47,719
Live stock		36,805		41,305
Coal		178,463		174,317
Coke		11,772		12,327
Forest products		72,100		70,700
Ore		55,774		52,159
Miscellaneous	(30%)	440,189	(40%)	442,431
Merchandise in less-than-carlot quantities		270,343		271,505
Total for week		1,120,645		1,112,463
Same week last year		1,087,954		1,077,006

Foreign Projects of Interest to Americans

Reconstruction of Yokohama harbor planned. The Japanese government has worked out plans in considerable detail for the contemplated reconstruction. Reference No. 181977.

South Africa plans important public construction projects. The Government of the Union of South Africa includes nearly $5,000,000 for new railways, about $10,000,000 for rolling stock, approximately $4,500,000 for harbor construction and other expenditures for public works such as buildings, bridges, irrigation, etc. Reference No. 181284.

Important power plant project proposed in Australia. Specifications are being prepared calling for tenders on a new power plant to be erected for the Municipal Council of Sydney. It is planned to have the new power-house opened in 1930. Reference No. 35 X.

Weekly Construction Market

KEEN competitive bidding by sub-contractors, carried to a point where the price bid is below that actually necessary to show even a small degree of profit, is being rapidly abandoned.

The result of this move will be higher figures bid on many future jobs, or the rapid dissolution of numerous contracting organizations.

Many prospective builders will accordingly stay out of the market until such time as costs are considerably lower than they are at present.

The other factor serving to curb the volume of future contract letting, is the possible tightening of present liberal credit extensions. Easy financing is probably responsible for much of the building of residences, apartments, hotels, warerooms and stores, offices and other buildings not classed as industrial.

This group, representing approximately 68 per cent of all construction, will be the first to show depression.

Industrial buildings, now representing about 6 per cent of all construction, will probably continue to show a gradual downward trend, since present factory space is not being used at 100 per cent of capacity. Public works and utilities, or regular engineering construction, is the one class expected to climb steadily upward in direct proportion to the continued increase of families for which provision must be made. This classification represents at least 26 per cent of all construction.

In the market for building materials, particular firmness is noted in pine lumber, lime, and linseed oil. Brick shows slight fluctuation. In the New York market common brick is $1 per M. higher than a week ago. Next month will no doubt show a decided gain in the amount of cement stored at mills throughout the country. Between 85 and 90 per cent of the shingle mills of Washington, Oregon, and British Columbia are closed down until production can be brought closer to demand.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products									
Structural shapes, 100 lb	$3.34	$3.90	$4.00	$3.10	$3.35	$3.07½	$3.30	$3.35	$4.25
Structural rivets, 100 lb	4.50	4.45	4.75	3.50	3.75	4.65	5.00	3.75	6.00
Reinforcing bars, ¾ in. up, 100 lb	3.24	3.40	2.80	3.00	3.25	3.77½	3.35	3.25	2.30
Steel pipe, black, 3½ to 6 in. lap, discount	48%	54%	53.6%	51%	54.25%	36%	39.2@51%	50%	59.49
Cast-iron pipe, 6 in. and over, ton	50.60@51.60	46.40	54.00	49.20@50.20	53.00	63.00	53.00	55.00	55.00
Concreting Material									
Cement without bags, bbl	2.50@2.60	2.25	2.05	2.20	2.42	2.84	2.31	2.65	1.80
Gravel, ¾ in., cu.yd	1.75	2.20	2.38	2.00@2.20	1.65	1.90	2.15	1.50	1.25
Sand, cu.yd	1.00	1.65	2.00	2.00@2.20	1.25	1.00	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd	1.85	2.20	2.83	2.00@2.20	1.75	2.50	2.15	3.00	1.90
Miscellaneous									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	61.00	34.00	+60.00	53.50	35.75	33.75	27.00	25.00	60.00
Lime, finishing, hydrated, ton	18.20	22.50	+20.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime, common, lump, per bbl	2.25@2.75	1.30	1.85	1.30	1.35	2.70	1.60	2.80	9.50
Common brick, delivered, 1,000	+17.50@19.00	10.50	—11.00	12.00	13.50	12.00	15.50	15.00	17.50
Hollow building tile, 4x12x12, per block	Not used	.0893	.10	.075	.....	.085	.....	.10	.12
Hollow partition tile 4x12x12, per block	.1027	.0893	.10	.075	.07	085	.108	.10	.10
Linseed oil, raw, 5 bbl. lots, gal	1.04¼	+1.10½	1.13	1.01	1.11	+1.23	1.15	1.12	1.25
Common Labor									
Common labor, union, hour	.55@.75	.30	....	.87½	....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	.....	.25	.30@.50	.82½	45@.55	.35@.50	.50	.50	.25@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net and hydrated lime, f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Labor—Concrete laborers' rate, 93½c.; building laborers, 75c.; excavating laborers, 55c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber, sand, gravel and stone delivered on job; pine is 4-in. instead of 3-in.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.60 for Sheboygan. Common labor not organized.

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of October 1, the next on November 5.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Brick and hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand, stone, gravel and lump lime per ton. Stone and tile are delivered; sand, gravel, lime and cement on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 101.156). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3½-in., $59.49.

Business Briefs

Call money quoted at 4½@5 per cent, Oct. 19; year ago, 2 per cent.

Time loans: short terms, 4¾@5 per cent; longer periods, 5 per cent.

Commercial paper: best names, 4½ per cent; other names, 4¾ per cent.

On October 1, 1925

E. N.-R. Construction Cost Index Number 205.35

E. N.-R. Construction Volume Index Number 262

For Explanation and Details of Indexes Since 1913 See the First Issue of Every Month